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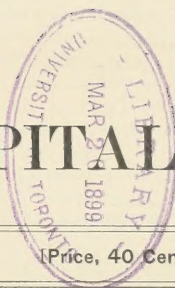
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# BULLETIN

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## THE DISSECTION AND LIBERATION OF THE SPHINCTER ANI MUSCLE FOLLOWED BY ITS DIRECT SUTURE IN CASES OF COMPLETE TEAR OF THE PERINEUM, WITH A SPLINTING SUTURE PASSING BETWEEN THE OUTER AND INNER MARGINS OF THE MUSCLE.

By H. A. KELLY, M. D., *Gynecologist-in-Chief, The Johns Hopkins Hospital.*

Although great progress has been made in gynecological plastic surgery within the past twenty years, there have been few or no changes in the treatment of complete perineal tears, that is, of those which extend through the external sphincter ani.

The common symptom of a complete tear of the perineum is the lack of a control over the functions of the bowel, characterized by the involuntary escape of feces and gases. These sequelae, however, are not invariably present in the same degree in all cases, and there is a diversity among them varying all the way from the entire loss of function on the one hand to perfect control on the other.

Some surgeons, reasoning upon supposedly physiological grounds, have gone so far as to assert that it is impossible for a woman with a divided sphincter to exercise any control whatever over the bowel function; I know, however, from repeated clinical evidences that perfect function may sometimes persist; it becomes therefore necessary to discover some satisfactory explanation of the facts rather than to deny them.

I would divide the cases of complete tear, to be investigated from this standpoint, into two groups. First, those in which the tear barely extends through the sphincter and goes no further, and, second, those in which the sphincter ends are separated by a well-defined interval of a centimeter or more.

In the first of these groups, where the muscle is only just divided and the ends lie close together, the cicatrization which follows the injury is a conservative effort on the part of nature, and soon results in the approximation of the ends of the muscle, knitting them firmly together, with only a plug of scar tissue between. In this event the muscle is no longer, in a true sense, a sphincter, as it cannot contract from all directions towards a central point, but is compelled henceforth, by the break on one side and the interposition of a plug of unyielding connective tissue, to contract up to the scar as a more or less fixed point, and this it does with greater or less efficiency. This peculiar effect produced upon the sphincter



by the interpolation of a mass of scar tissue was pointed out many years ago by Hildebrandt.

The second group relates to those cases in which the sphincter ends are not bound together; I have at present under my care a patient with a complete rupture of the perineum, with deep, perfectly marked sphincter pits, separated by the entire breadth of the anal orifice, with a relaxed everted vaginal outlet and a uterus in descensus and retroflexion, and yet she has absolute control over fecal movements, whether formed or liquid, and is never disturbed by involuntary escape of gases. What is the explanation of this fact?

A careful physical examination shows that the patient has perfect voluntary control over the internal sphincter muscle, extending from the external sphincter about 2 cm. upwards.

The tonic contraction of the internal sphincter and its response to a voluntary effort can be most readily tested in *propria persona*. If the tip of the finger is well oiled while sitting in a warm bath and inserted about an inch into the bowel while slightly bearing down to relax the sphincter, then, upon causing a voluntary contraction, a prompt response on the part of the internal sphincter will be noticed. When not voluntarily relaxed, the internal sphincter is in a state of tonic contraction guarding the orifice, while the external sphincter is not always contracted.

I believe, therefore, from repeated clinical observations that the tonic control exercised over the bowel functions resides rather in the internal sphincter than in the external, and that the external sphincter muscle is a provision against an emergency and is intended to form a temporary, powerful supplement to the internal sphincter.

The external sphincter is of further use in the act of defecation, in breaking the fecal column at intervals, so tending to prevent prolapsus recti by creating a pause in the act and allowing time for more material to pass down into the rectum before the renewal of the straining.

This physiological fact explains the reason why, when the external sphincter ends lie close together and the internal sphincter is therefore uninjured, continence is always preserved.

I would add, too, to this category of manifest sphincter injuries, a much larger group of cases in which, owing to the fact that control over the bowels is retained, as well as owing to the natural, uninjured appearance of the anus, suspicion is disarmed, and the surgeon, even when he is brought into such close contact as is involved in the performance of a perineal operation, fails to recognize the fact that the sphincter ends are divided. I cannot sufficiently emphasize the importance of this observation, and therefore reiterate my conviction that many women have torn sphincters which are never discovered.

When the ends of the external sphincter muscle are separated by any considerable interval in a recent tear, then the internal sphincter is also torn, and, the wider the separation of the external sphincter ends, the greater the tear into the bowel and therefore of the internal sphincter above. What is true of the recent injury is true *a fortiori* several months later, when a wide tear is drawn down to a narrow line and an interval of 1 cm. between the pits may represent a rupture 3 cm. in depth. It is therefore to this tear of the internal sphincter that the loss of control over the bowel functions is due.

**OPERATION.**—The prevailing operation in this country is the Emmet, which I need not describe in detail as it is so well known. The operations practiced in Europe for the most part are of a similar nature, or flap-splitting or Hegar's method. The important principle in the Emmet procedure consists in the application of a series of sutures, to an area thoroughly denuded, first closing the bowel, then radiating out from the bowel, over the skin and onto the vaginal surfaces. Emmet further lays great stress upon a tension suture entering and emerging at points outside of and well behind the external sphincter ends and traversing the septum, for the purpose of supporting and keeping all the fibres of the sphincter ends together. Dr. Emmet told me on one occasion that the devising of this suture cost him more thought than almost anything he had done in gynecology.

Although this operation, as well as the others mentioned, when well carried out, succeeds admirably in many instances, it still leaves much to be desired in that there does remain a residuum of failures, and a considerably larger percentage of cases in which the function is so imperfect at first that we are obliged to wait weeks or months for the patient to gain a satisfactory control, and sometimes in this latter group there are women who will tell you that when their bowels become loose they always find their clothes more or less soiled, while they are also apt to be uncertain about the control of gases.

In order to meet the various objections to the operation as practiced at present, I have devised several procedures based upon the physiological principles dwelt upon above; the first important point is the dissection and liberation of both ends of the sphincter muscle, after which they are sutured together with buried cat-gut sutures, end against end.

I can perhaps best emphasize the importance I wish to give this step by citing the first case in which I was led to operate in such a way.

**CASE I.**—The patient was brought to me in Dec., 1897, by Dr. J. A. Sexton, of Raleigh, N. C. She had had six previous operations performed for complete tear of the recto-vaginal septum, and upon inspecting the parts I found perfect union throughout, a pathologically small well-closed anus, and a far better result in the external appearance than is often secured in cases which are deemed successful. In spite of appearances, however, she had no control over the function of the bowel, and the gases escaped audibly at all times, and formed movements were discharged at once without the slightest ability on her part to restrain them (Fig. 1).

I was disinclined from my examination to do anything further to this patient, after all she had passed through, doubting whether I could improve her condition, but through Dr. Sexton's kind insistence I felt at last forced to make at least an earnest effort to better her state. So I operated Dec. 8, 1897, determined to make a clean dissection of the external sphincter, even, if necessary, going so far as to lay the entire muscle bare, so as to make sure of bringing its ends into apposition, and leaving the end of the bowel encircled by a good muscular ring, if one could be found in the neighborhood.

I began the operation by making a semilunar incision with its convexity directed towards the symphysis, half way round the anal orifice and about 1 cm. from the anal margin (Fig. 1). As the dissection through the scar tissue was carried into the perineum, the edges of the incision were drawn in opposite directions, exposing a wide crescentic area. I found now that the sphincter could be beauti-



fully demonstrated anatomically, and that the right end lay nearly in the normal position, but fixed in the median scar, while the left end lay at least  $2\frac{1}{2}$  cm. distant from the right end, and was attached to the tuberosity of the ischium (Fig. 2). After laying bare and freeing 2 cm. of each of the ends, I then trimmed off the scar tissue so as to expose fresh red muscular bundles, which I then united with three interrupted buried cat-gut sutures, simply transfixing the sphincter muscle 5 or 6 mm. from the cut ends. Two buried sutures were also used in the septum in the deeper fat layer of the wound, and the skin wound was finally closed with fine silk sutures (Fig. 3). The result was a perfect union and greatly improved control of the bowel from the first. I examined the patient again two months later, and passing a finger a short distance into the rectum and grasping the sphincter between finger tip and thumb could distinctly isolate it on all sides, and on telling her to contract the muscle I could feel that it was perfect throughout and under complete control.

I do not know of any other instance in which with an apparently well-formed anal orifice the sphincter muscle has been laid bare and the separated ends freed from their attachments and then joined by buried sutures.

Following the initiative of this case, I at once incorporated the dissection, isolation and separate suture of the sphincter muscle as an essential part of the technique of all my operations for complete tears, intending in this way to insure the bringing of the sphincter into the field as well as the exact union of its parts, end to end.

CASE II.—The next case was one of the classical sort, a secondary operation for complete tear where the parts had well cicatrized.

She was operated upon towards the end of February, 1898. She had had a complete tear of the perineum in consequence of a forceps labor conducted by myself in the preceding December; the immediate suture failed, and since that time she had had no control whatever over the bowel function. In place of the perineum there was a boat-shaped cicatrix extending from two lateral prominences marking the former position of the fourchette, extending back to the anus. The recently cicatrized tissue fairly marked out the extent of the original tear in somewhat diminished form. I proceeded by denuding the vaginal sulci and the lateral surfaces as usual. I then exposed the sphincter ends by turning down a triangular flap of uninjured skin lying in front of the anus (see Fig. 4), catching the ends in their pits one at a time, pulling them up and out a little, and snipping with blunt-pointed scissors on all sides of the eminence until each sphincter muscle stood dissected out with perfect distinctness about 2 cm. beyond the surrounding tissue. On lifting the ends up the pull on the posterior part of the sphincter could be distinctly felt with the thumb and forefinger grasping the margin of the anus. The exposed ends were then denuded of the film of scar tissue covering them and brought evenly together with interrupted cat-gut sutures; the flap which was turned down over the bowel during the dissection was then brought up over the sphincter, and the rest of the wound closed as usual. The result was a perfect control over the function of the bowel from the very first, leaving nothing to be desired in respect to function, and the patient has now, a year later, absolutely normal control.

CASE III.—In my third case I was obliged to follow a somewhat different procedure, as the sphincter pits were not well enough marked for me to be sure of their identity. After making the usual denudation I then made two incisions parallel to the sides of the anus and extending downwards from the denuded area about  $1\frac{1}{2}$  cm. on either side (see Fig. 5). On pulling apart the tissues and dissecting inwards, the sphincter muscle was then clearly exposed, freed from its bed, and the ends cut off (Fig. 6). The rectal part of the tear was now closed by interrupted sutures applied on the rectal side down to the sphincter area, and a short distance out onto the skin surface

(Fig. 7). The sphincter ends were then denuded and brought together with buried interrupted cat-gut sutures passed through them, after which the rest of the wound was united as usual (Fig. 8), and the para-rectal incisions carefully closed with interrupted cat-gut sutures.

Since then the following cases given in abstract have been operated upon in my clinic by Drs. Russell, Ramsay and myself.

CASE IV.—B. D., married, age 23, white.

*Diagnosis.*—Complete tear of perineum.

*Operation.*—Restoration of ruptured recto-vaginal septum.

The patient has been married five years and has had two children and one miscarriage. The first labor was difficult and instrumental, at the second the child was still-born, while one month previous to admission, the miscarriage had taken place at four months.

Ever since the birth of the first child, three years ago, she has had a descensus of the womb, with bearing-down pains in the abdomen, pain in the back and headache, all of which symptoms have been worse during the past 3 months, the prolapse now being marked. The bowels move regularly every day.

*Examination* under ether showed: Extensive tear of recto-vaginal septum, through sphincter ani and up left sulcus, the tear apparently extending one inch into rectum.

*Operation* by Dr. Kelly, March 12, 1898. The usual Emmet denudation was made, and, in addition, the sphincter ends were dissected and pulled out on either side, 3 cm. on right and  $2\frac{1}{2}$  cm. on left, clear of all surrounding tissue. About 3 mm. of the ends were cut off to remove the white scar tissue and to present an even muscular surface; the ends were then sutured directly together with 4 cat-gut sutures and dropped and buried.

The septum was first united down to the sphincter, after which the sphincter was united, and then the remaining portion of bowel and finally the vagina and perineum. A silk-worm-gut tension suture was inserted behind the sphincter ends but not so far posteriorly as usual. Duration of operation, 35 minutes.

*Convalescence* was uninterrupted; the healing was *per primam* and the result perfect; the patient had perfect control of the bowel from the very first. Maximum temperature  $98.8^{\circ}$  (2d day). Discharged well April 2, 1898.

CASE V.—F. G., married, age 26, white.

*Diagnosis.*—Retroflexio uteri; tear of the perineum, extending through the sphincter ani.

*Operation.*—Suspensio uteri; restoration of ruptured recto-vaginal septum.

The patient on admission complained of pain in the bladder and misery in the back. She had been married seven years; had had three children and no miscarriages. All three labors were difficult, the first two were instrumental, and in both these the outlet was lacerated with no attempt at subsequent repair. The last child was born two years ago.

The bowels were extremely constipated; she had hardly any control over them, especially as regards flatus.

*Examination* under ether showed: Outlet greatly relaxed; complete tear of perineum, extending through into bowel, the sphincter pits being distinct on either side; uterus in retroflexion.

*Operation* by Dr. Kelly, April 13, 1898.—Denudation in sulci and on lateral walls of vagina as usual, extending down to rectum and laterally to sphincter pits; ends of sphincter dissected out and caught with forceps; rectum brought together in the usual way by interrupted cat-gut sutures, tied on the rectal side; ends of sphincter muscle freshened and brought together with 4 cat-gut sutures; a deep silk-worm-gut tension suture was also inserted behind the sphincter ends; rest of closure in usual way. Uterus suspended in usual way. Time of complete operation, 75 minutes.

The *convalescence* was marked by a partial breaking down of the perineal incision, with some suppuration, but the perineum was



well lifted up, and introduction of finger into rectum showed good sphincter action, except anteriorly, while the patient seemed to have good control over her bowels. The maximum temperature was 100° (on the 7th day). The patient was discharged May 10, 1898.

*Subsequent note*, Aug. 27, 1898.—Result of perineal operation is fair; some bulging of anterior vaginal wall, and pressure upon it and upon uterus causes discomfort. Sphincter ani has apparently its full power. Since leaving the Hospital the patient has improved in general health and is free from her old trouble, except some pain in the back and painful micturition.

Cystoscopic examination showed that the bladder was inflamed and infected, especially about the region of the trigonum, while the urine showed a great number of pus cells and a small amount of albumen.

CASE VI.—L. E., married, age 30, white.

*Diagnosis*.—Complete perineal tear.

*Operation*.—Restoration of ruptured recto-vaginal septum.

*Marital history*.—Married four years, two children and two miscarriages. The first labor, three years ago, very difficult, although not instrumental; the patient was lacerated, and the laceration was repaired, but not successfully; the second labor, one year ago, was not difficult.

Since birth of first child, she has had prolapse of uterus after standing for some time, the uterus returning to its place on lying down. Has absolutely no control over her bowels and but little over urination. Feels as if bladder prolapsed with the uterus. The patient suffers with dragging pain in the back and loins. All these symptoms have been worse since the birth of her last child.

*Examination*.—Complete tear through perineum and sphincter ani muscle, about one inch of the bowel being seen. Uterus in anteposition, low down in pelvis. Outlet greatly relaxed.

*Operation* by Dr. Russell, April 28, 1898.—Tear extended  $3\frac{1}{2}$  cm. beyond sphincter into bowel. Sphincter ani ends were dissected out free; the mucous membrane was united above the sphincter by interrupted cat-gut sutures; the ends of the sphincter were then united directly with 4 cat-gut sutures, 1 tension silk-worm-gut suture going from side to side through the skin and the septum. The outlet was then restored in the usual manner. Time of operation, 50 minutes.

The convalescence was uninterrupted; the bowels were well moved on the fourth day; the wound healed perfectly; the sphincter ani has good power, and the patient has perfect control of her bowels.

The patient's maximum temperature was 100° (2d and 7th days). The patient was discharged May 20, 1898.

CASE VII.—M. B., age 32, married, white.

*Diagnosis*.—Large retroflexed uterus with descensus; lacerated cervix; complete tear of vaginal outlet with concealed tear of sphincter ani.

*Operation*.—Trachelorrhaphy; restoration of ruptured recto-vaginal septum; suspension of uterus.

*Married* 13 years; has had three children and one miscarriage; all three labors were prolonged and very difficult, and the perineum was badly torn each time, the worst tear being at the last delivery, three years ago. No one of the labors was instrumental.

Since the birth of her second child, six years ago, the patient has had dragging and bearing-down pains in the lower abdomen, aggravated by walking or climbing, with progressively increasing loss of strength and loss of weight. Micturition has been increased in frequency and is occasionally painful.

The bowels are generally regular, but, since the birth of the last child, she has had difficulty in controlling the fecal movements whenever the bowels are loose.

*Examination*.—Uterus is enlarged and retroflexed. The vaginal outlet is so relaxed that the cervix is visible. A tear is seen extending up the median line into the rectum about two cm. in length. Slight lateral indentations indicate the possible position of the

sphincter ends and this is verified by palpation or stimulation; the sphincter retracts on all sides except in front. The lips of the cervix are everted and congested.

*Operation* by Dr. Kelly, June 18, 1898.

Dilatation and curettage with the removal of abundant endometrial detritus. The lacerated cervix was repaired next, and then the vaginal outlet, including the sphincter ends; after the denudation of the wound area the sphincter ends were dissected and drawn out to the extent of 1 cm. Some scar tissue was then cut off the ends to make them square and fresh. The rectal side of the tear was then closed with six cat-gut sutures down to the sphincter ends; the ends were then pulled out and held so, while a *silk-worm-gut suture* was passed through the skin, through one sphincter end across the septum and out through the opposite sphincter end and through the skin again. The sphincter ends were then accurately approximated by three cat-gut sutures. The rest of the operation was performed in the usual way.

The uterus was also suspended through an abdominal incision. Time of complete operation, 55 minutes.

The convalescence was uninterrupted; the healing was perfect; the vaginal outlet was well lifted up, with the cervix in good position as well as the uterus and the patient had perfect control of her bowels. Maximum temperature 99.8° (third day). Patient was discharged July 16, 1898.

CASE VIII.—E. N., married, age 47, white.

*Diagnosis*.—Multiple cervical polypi. Polyp of posterior vaginal wall. Rupture of recto-vaginal septum.

*Operation*.—Removal of polypi; amputation of cervix; repair of perineal tear.

*Marital history*.—Married at 18, seven children (oldest 25 years, youngest 5 years). Always had normal labors and was never attended by a doctor.

*Menstrual history*.—For the past six months has had frequent hemorrhages until a few (5 to 6) weeks ago, since then no flow at all. Associated with the hemorrhages were pains in legs and pelvic regions, which have continued up to the present time, occasionally associated with "colicky" pains in left hypochondrium. Bowels were usually regular up to the time of the hemorrhages, since which time they have been constipated. Micturition has increased somewhat in frequency of late. Urine is negative.

*Examination* under ether showed: Outlet gaping; complete tear of recto-vaginal septum, sphincter pits being definitely marked on both sides, with a bridge of scar tissue holding the ends of the muscles together. Several cervical polypi; one polyp of vagina; uterus enlarged, but in anteposition.

*Operation* by Dr. Ramsay, June 19, 1898.—Removal of vaginal polyp; amputation of cervix with its attached polypi; the denudation of the complete tear was made in the usual way to the sphincter pits; the ends of the sphincter muscle were caught, drawn out and dissected free. Cat-gut was used to draw together the bowel above the sphincter; the sphincter ends were then brought together with three cat-gut sutures, with a silk-worm-gut suture through the muscle and the septum to relieve tension. The closure of the rest of the wound was performed in the usual way. Time of entire operation, 90 minutes.

The convalescence was uninterrupted; the healing was per primam, while by rectal examination the sphincter ani muscle could be felt contracting all around. The patient complained slightly of some pain in the left inguinal region which was relieved by enemata of starch water and fluid extract of Hamamelis. The maximum temperature was 100° (on 2d day). Patient was discharged well on July 20, 1898.

CASE IX.—Mrs. C. H., married, age 36, white.

*Diagnosis*.—Complete perineal tear; relaxed vaginal outlet.

*Operation*.—Restoration of ruptured recto-vaginal septum.

The patient has been married 16 months and has had one child,

born 15 weeks ago; she was in labor three days, and the delivery was finally completed by instrumental interference, during which she was badly torn, both at outlet and cervix; an unsuccessful attempt was made to repair the septum. Since the childbirth she has had severe pains in back and pelvis, with partial loss of control of the bowels, especially marked when the movements are loose. As a rule however the bowels are constipated.

*Examination* under ether showed: Outlet much relaxed, with a tear through the recto-vaginal septum. Sphincter pits are easily seen, the one on the left side being pulled  $2\frac{1}{2}$  cm. from the position in which it is usually seen (apparently by the transversus perinei muscle). Uterus in ante-position and freely movable.

*Operation* by Dr. Kelly, June 27, 1898.—On palpation sphincter ani muscle felt easily posteriorly and laterally but not anteriorly. A verticle cut 1 to 1.5 cm. long exposed the sphincter ends. The sphincter was dissected out, the ends pulled out to the extent of 2 cm. and splinted by a *silkworm-gut suture passed through the muscle and up through the septum* and left united for the present. The vaginal wound was closed, doing away with the relaxation; the rectal tear was closed and then the silkworm-gut suture was tied and the sphincter ends united by four cat-gut sutures, with two silkworm-gut sutures to perineum above and the rest cat-gut, making good closure throughout. Time of operation, 38 minutes.

The *convalescence* was uneventful until July 10, when, on the removal of the external stitches, although the wound had apparently healed well, the sphincter held well, and the patient apparently had perfect control of the rectum, it was found that there was a recto-vaginal fistula, the fistulous opening being around the internal vaginal suture on the left side. On the removal of this a good deal of soft fecal matter oozed through the opening, through which a sound 3 mm. in diameter could be passed.

This of course necessitated a *second operation*, which was performed on July 14, 1898. The sphincter was found to have held well; the fistula was just within the vagina and opened into the rectum about  $1\frac{1}{2}$  cm. within the anus. The sphincter was first dilated, and through the sphincter the rectal opening of the fistula was found; its edges were now pared and freshened on the rectal side; the vaginal side was then freshened in the same way. The rectal mucosa was closed with fine silkworm-gut sutures, with the knots turned into the bowel, and the vaginal opening was closed in the same way, with the knots toward the vagina. A rectal plug was then inserted.

The *convalescence* from this second operation was uneventful, except for the difficulty in moving the patient's bowels. Perfect healing took place, and the fistula was obliterated. The maximum temperature was  $101^{\circ}$  (sixth day after first operation). The patient was discharged on Aug. 2, 1898.

The patient was readmitted Sept. 9, 1898. She complained of pain at stool, which had been present ever since her discharge from the Hospital, with discharge of liquid material at times; the sinus seeming to heal for a day or two and then at stool to break down again.

*Examination* under ether showed: The sphincter ani muscle forms a complete ring around the anus, with normal radiating lines surrounding the orifice; while a sinus, slightly to the left of the median line in the perineum, opens just within the sphincter muscle; extending also  $1\frac{1}{2}$  cm. up in the recto-vaginal septum.

*Operation* by Dr. Russell, Sept. 14, 1898.—The sinus and the indurated tissue about it were dissected out; the opening in the rectum was enlarged by paring the edges and was then closed by five cat-gut sutures, passed on the rectal side. A few buried cat-gut sutures were also introduced on the perineal side. The perineal incision was then closed with interrupted silkworm-gut and cat-gut sutures. The *convalescence* was uninterrupted, the healing was perfect, the temperature never rose above  $99^{\circ}$ , and closure was complete. The patient was discharged Oct. 7, 1898.

CASE X.—C. C., married, aged 38, white.

*Diagnosis*.—Relaxed vaginal outlet. Rupture of sphincter ani muscle.

*Operation*.—Dissection and direct union of the ends of the sphincter ani. Resection of the relaxed outlet. Curettage of cervix.

*Marital History*.—Has been married 15 years. Has had four children, no miscarriages. All the labors were extremely protracted and difficult. The first and fourth labors were instrumental; the third child was still-born. After the birth of the first child she had convulsions. At her last labor she was badly torn, the tear extending to the anus, but no attempt at repair was made. Phlegmasia alba dolens complicated her last puerperium. The first child is fourteen years old, the last (if living) would be two. The laceration mentioned above has never troubled her. The bowels are perfectly regular and under control, while there is an increase in the frequency of micturition.

*Examination* under ether showed: Tear of perineum through sphincter muscle and 1 cm. into the bowels above; the ends of the muscle widely separated and connected by a narrow band of scar tissue; a slight bilateral laceration of cervix; uterus of normal size and in ante-position.

*Operation* by Dr. Russell, August 1, 1898. The operation was performed in two steps.

(1) A semilunar incision was made at anal orifice at junction of skin and mucosa, the flaps were dissected back and the ends of the sphincter ani muscle exposed; the mucous membrane was united by cat-gut sutures, and then the muscle ends were drawn together and sutured with five cat-gut sutures. The primary incision was then united from side to side.

(2) The relaxed vaginal outlet was then resected in the usual way. Time of entire operation, 50 minutes.

The *convalescence* was only interrupted by the inability of the patient to void her urine and the consequent necessity of catheterization for the first week, followed by a mild cystitis, relieved by vesical irrigations.

The maximum temperature was  $100^{\circ}$  (on the second and eighth days). The wound in the rectum healed per primam; perfect union of the sphincter muscle was obtained, with perfect control of the rectum. There was a slight infection of one of the vaginal stitches. The patient was discharged well, September 1, 1898.

CASE XI.—Mrs. C. W., married, aged 43, white. Private hospital.

*Diagnosis*.—Complete tear of the perineum.

*Operation*.—Repair of the complete tear. Dissection and direct suture of the sphincter ani.

The patient has been married 23 years and has had six children, the youngest three and a half years old, and one miscarriage in 1890.

She was badly lacerated at her first confinement, when the delivery was instrumental (22 years ago); this was repaired by Dr. Helmuth, in 1891, and the perineum was ruptured again at the birth of her last child, three and a half years ago.

She complains of general poor health, frequent attacks of diarrhoea, and especially of an escape of gas from the vagina; she has also noticed fecal matter in the vagina; and often has great difficulty and sometimes entire inability to control the movements of the bowel.

*Examination* showed: The vaginal outlet torn through and the sphincter ends widely separated; the perineum boat-shaped, with much scar tissue between the vaginal and rectal openings, and the injury to the sphincter ends might easily be overlooked; the sphincter ends marked by pits two cm. apart.

*Operation* by Dr. Kelly, November 22, 1898. Denudation as usual, removing scar tissue over sphincter ends and freshening the torn septum, extending up both right and left vaginal sulci. In including the sphincter ends, the incisions marking out the area for denudation were made differently from the rule by



cutting about three mm. away from the pile. This was done so as to give the sphincter a wider berth, so that when the sphincter ends were united by buried sutures they would not lie so close to the skin surface as they would if the incision was made close to the ends. Both sphincter ends were caught with forceps, pulled up and dissected out with a pair of blunt scissors until they appeared about one and a half cm. long above the surface. The glazed white ends were then cut off, and the rest of the denudation completed, and the bowel above freed from the recto-vaginal septum.

The rectal rent was then closed by fine interrupted silk sutures passed on the rectal side, entering and emerging on the mucosa about one cm. from the margin of the cut.

After closing the rectal rent, the sphincter was united by two cat-gut sutures and splinted by silkworm-gut sutures entered about one and a half cm. back of the edge of the cut in the anal margin, and carried up through the septum, piercing the sphincter both on entering and emerging. Another suture was passed well behind this first one, up through the septum outside the sphincter as recommended by Emmet.

The skin margin was very carefully closed up over the sphincter, and the rest of the wound in vagina and perineum united as usual, extreme care being taken not to leave any dead spaces. The intelligent patient had perfect control over the sphincter from the first, and at once recognized the great difference in her condition. She made a prompt recovery and returned home entirely well.

The one remarkable and constant fact specially noted after each of these operations was the immediate sense of restored power which was discovered by the patient as soon as she was well over the effects of the anesthesia; there was a sense of natural control over the function of the bowel which had been absent since the injurious confinement.

In conning the literature of this subject I have discovered several interesting references which have a direct bearing upon the method described. In the first place Dr. R. L. Dickinson,\* has pointed out in an admirably clear paper devoted to the study of recent injuries to the sphincter ani, the important fact that the rupture of the muscles crossing the pelvic floor, in common with the external sphincter, is never median. The tear takes the direction of least resistance and avoids the aponeurotic web where the structures interlace in the middle line, breaking through laterally and severing the transverse perineal muscles and the sphincter well to one side. Out of sixteen cases ten were on the right, six on the left side, while another involved both sides of the sphincter. A close examination will always reveal an asymmetry, and not infrequently one end of the sphincter is found hanging out free on one side of the rupture, while the opposite side presents a deep pit from which it has been torn out. At the bottom of this pit is the other sphincter end. With the changes which take place during the period of cicatrization and contraction, well delineated by Kuestner and Leopold, this asymmetry is reduced to a minimum so that there finally remains but a slight obliquity in the level of the sphincter ends as a small index of a large difference earlier in the history of the case.

In these recent tears Dr. Dickinson with good surgical judgment used buried cat-gut sutures to bring the sphincter ends together; he says: "Two buried cat-gut sutures carried through the free hanging end of the muscle and then down into the pit to catch the hidden end, draw the parts into accu-

rate apposition. The rest of the injury is then repaired as usual."

Sawaisky in an inaugural dissertation published in St. Petersburg, 1895, describes a method of treatment employed in Prof. Lebedeff's clinic in six cases of complete rupture. The recto-vaginal septum was first split as in performing a flap operation, and then after extending the wound sufficiently up onto the vulva the ends of the sphincter were caught and united with an interrupted suture, after which the major part of the wound was closed with a continuous cat-gut suture, and the closure was completed with four deep and two superficial sutures.\*

In an article by Leopold and Wehle†, a method of uniting the sphincter is described by which two or three sutures are passed through the skin close to the sphincter, brought out in the sphincter pit and re-entered on the sphincter on the opposite side to reappear on the skin surface at a point corresponding to the point of entrance. By this means the suture ends are approximated with far greater accuracy and with a degree of certainty unknown in the old operation; this is practically the same method I have been practising myself for a number of years past.

Dr. George E. Shoemaker, in a personal letter received January 14th, 1899, states that he operated upon a tear of the sphincter ani muscle in June, 1893, which was referred to briefly in the *Medical News* of September 22d, 1894. Two previous operations, both unsuccessful, had been performed on the patient for the same trouble which had originated in 1891. Dr. Shoemaker's operation was begun by making a curved incision from over one sphincter end across to the other. The sphincter muscle ends were then dissected out and clearly defined, after which they were caught up by a strong cat-gut suture which included only the two sphincter ends. The rectal wall was closed in the usual way and the Emmet intra-vaginal denudation completed, two reinforcing worm-gut sutures being passed through the sphincter, each beginning far out on the skin at the side and ending at a point opposite.

The operation was entirely successful and the patient secured perfect control of the bowel.

Since this operation Dr. Shoemaker states that he has used this method repeatedly with entire satisfaction.

In a brief but suggestive paper Dr. R. G. LeConte‡ describes the direct suture of the sphincter ends by means of a buried cat-gut suture passed after the fashion of a tendon suture; the sphincter ends are hooked up and drawn forward and freshened either by cutting off a small portion with the scissors or by fraying the ends well with a knife, as already advised by previous operators who have insisted on freshening the sphincter ends as essential to secure good union; two cat-gut sutures are then applied one on each side of the sphincter muscle, and two more on the opposite side; when the opposed sutures are tied the sphincter ends are approximated. Dr. J. M. Baldy skillfully carried out Dr. LeConte's suggestion with remarkable success upon a patient who had been twice previously operated upon with an unsuccessful result each time.

\* See reference in Frommel's Jahresbericht, Vol. 7, p. 202.

† Geburtsb. u. Gynaek., Bd. 2, Leipzig, 1895, p. 307.

‡ Amer. Jour. of Obst., June, 1895.

\* Amer. Gyn. and Obst. Jour., May, 1895.

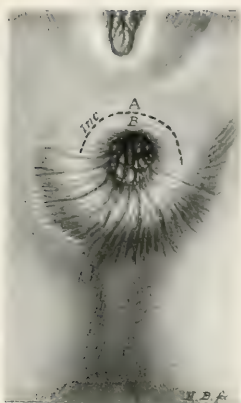


FIG. 1.—Showing the natural appearance of orifice after six attempts to restore the sphincter and secure control over the bowel function. The dotted line shows where the incision was made to expose the sphincter ends. A and B are pulled apart as shown in the next figure.

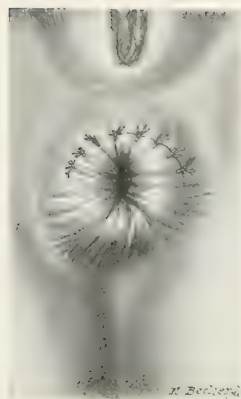


FIG. 3.—Appearance after the union of the sphincter ends and the closure of the skin wound, with interrupted silk sutures.

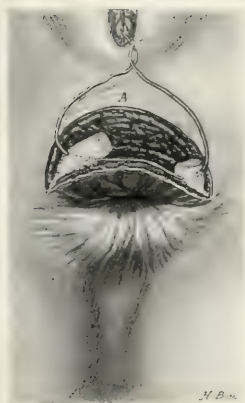


FIG. 2.—Shows the sphincter ends as they were found on pulling flap A up and flap B down. The right end lay near the median line and the left displaced attached close to the tuberosity of the ischium. One of the suture lines in place ready to bring sphincter ends together.



FIG. 4.—Showing skin flap held down and sphincter ends united by 8 interrupted silk sutures. This was a case of deep injury of the sphincter without tear of the skin over the anus and without a tear into the lumen of the bowel.





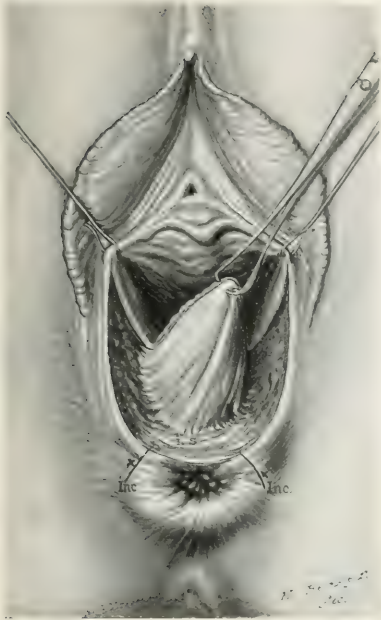


FIG. 5.—The denudation on vaginal and perineal surfaces. The tongue of tissue in the middle lifted up and dissected loose from the internal sphincter (i. s.). The denudation does not, however, expose the external sphincter, which is in this case laid bare by the two incisions (Inc.) parallel to the anal orifice.

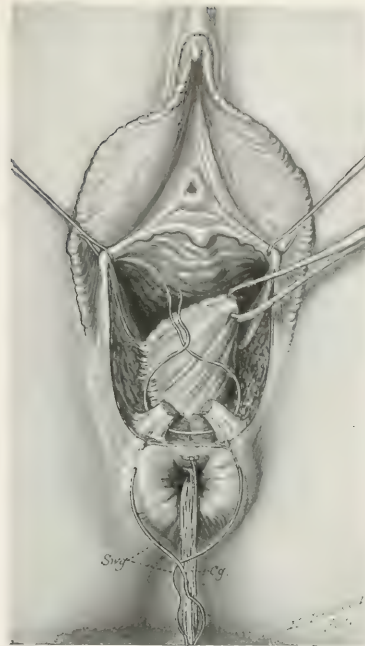


FIG. 7.—Denudation completed and rectal sutures tied, uniting the internal sphincter and radiating out into the skin surface.

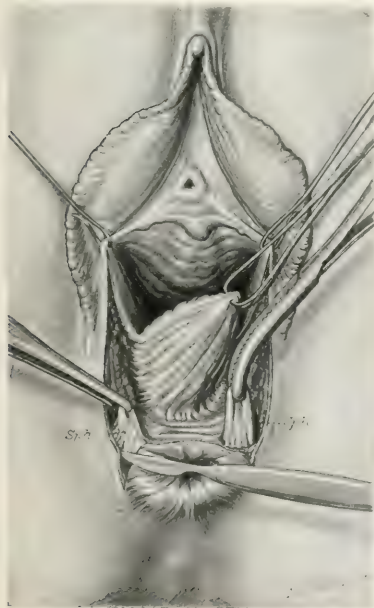


FIG. 6.—The incisions made as shown in Fig. 5, and the sphincter ends bared by dissection.



FIG. 8.—The rectal sutures all in place and the sphincter Sph ends united by 3-barbed catgut sutures. A worm gut tension suture passes through the centre of the sphincter muscle up around through the septum.





My own method of treating the sphincter is similar to those detailed, in so far as the muscle is united directly end to end by means of buried interrupted cat-gut sutures, and I would prefer passing single sutures directly through the muscle to the use of tendon sutures, for the reason that the simple interrupted suture buries less foreign material, and it is therefore less liable to infection, lying as it does close under the skin.

The first essential point of difference between my own method and those of previous operators is a carefully conducted denudation, giving the sphincter a wider berth, so as to separate it from the skin surface, after all the parts have been brought into apposition, by a greater interval. This is done to make the burial of the cat-gut sutures a safer procedure.

The next important point is the dissection and liberation of the sphincter ends until one, or one and a half centimeters or even more are pulled out free on each side. This has not been proposed before. The ends are then cut off so as to remove the scar tissue and three interrupted cat-gut sutures passed through them so as to be ready to bring them snugly together at the proper time.

The rectal wound is then completely closed by a series of interrupted sutures passed close together so as to make it impossible for any minute particles of fecal matter to press between the stitches and cause an infection. This closure is carried down and over the anus onto the skin area, and then, only after this step is satisfactorily completed, are the sphincter ends brought together and the buried cat-gut stitches tied. Another point which I wish to urge, which differs from any previous proposition, is the passage of a silkworm-gut tension suture directly through the substance of the sphincter muscle half way between its outer and inner borders. The purpose of this suture is to take the tension off from the buried cat-gut sutures during the healing process. I prefer this suture to the Emmet tension suture which is passed well behind the sphincter ends on the skin surface, because my suture acts more directly and does not tend to make the anal orifice so small; it is therefore easier to secure earlier and regular defecation.

I have dwelt thus far upon the method of securing immediate union of the external sphincter muscle; it is my desire now in conclusion to insist upon the importance of paying equal attention to securing accurate approximation of the internal sphincter muscle. Indeed, if I would establish any comparison between the two, I would attribute more importance to the accurate union of the internal sphincter than to that of the external. This must be effected in the following manner: One or two fingers are passed into the torn bowel and the thin septum is brought slightly forward, while with a knife or a pair of scissors the operator splits the septum on its mucous margin and then dissects upwards and inwards, separating the vagina and its columna from the septum in such a way as to isolate the rectum in front and on the sides. By taking a little care and observing the tissues closely, the bowel with the muscle is

easily set free, and if the dissection is well done the internal sphincter fibres will be clearly recognized on both sides.

After all the scar tissue is removed the internal sphincter is then united by a series of interrupted fine silk sutures entering and emerging on the mucous surface of the bowel about a millimeter from the edge of the cut. These sutures are passed and tied from above downwards from one and a half to two mm. apart; in a case recently operated upon I used as many as sixteen of them before the bowel was closed down beyond the external sphincter.

I believe it is best to reinforce these rectal sutures by two or three cat-gut sutures buried in the septum above them and grasping the muscular coat of the bowel, that is to say, the internal sphincter, and drawing it together over the line of union established by the first set. After doing this the external sphincter is brought together as described above, and the remaining perineal and vaginal portions of the wound united as described in the text-books. The utmost care must be taken throughout not to leave any dead spaces in the septum or about the buried sutures.

After such an operation it is my practice to open the bowels at least every other day by giving a warm oil injection through a soft catheter.

**NOTE.**—I have received a communication from Dr. J. M. Baldy, of Philadelphia, under date February 9, 1899, in which he refers in detail to his own practice of suturing the sphincter muscle directly in the following language:

"As to the method I am using, at first I made a partial ligation of both ends of the muscle, after dissecting them out and freeing them for a quarter of an inch from all attachments. After securing the muscles with catgut the balance of the operation was performed like Emmet's. I found in several cases that the ends of the muscle sloughed—one case resulted in a cure, another did not, and I had to do it over. Consequently I changed the method to a simple suture of the ends as I would suture the ends of anything else, ligating as it were only one side, so as to give more security in holding the ends together, and at the same time save the chance of cutting of the muscle circulation and producing a slough. Then I finish as an Emmet, passing the lower sutures (silkworm-gut) through the sphincter far below the points of union so as to take off all tension from the catgut in the muscles.

When I get a very tight sphincter (or anus) I slip a small subcutaneous knife into the tissue at the posterior margin of the anus and sever as many of the sphincter fibres posteriorly as it is necessary to allow me to stretch the anus sufficient to give a free opening—that is, enough to allow the easy passage of my thumb. I always stretch the torn sphincter before beginning any denudation or dissection whatever.

The patients have sure and absolute control before they leave the Hospital. It is a big improvement over the old methods."

## DESCRIPTION OF THE JOHNS HOPKINS HOSPITAL.

By JOHN S. BILLINGS, M. D., LL. D.

Containing 56 large quarto plates, phototypes, and lithographs, with views, plans and detail drawings of all the buildings, and their interior arrangements—also wood-cuts of apparatus and fixtures; also 116 pages of letter-press describing the plans followed in the construction, and giving full details of heating-apparatus, ventilation, sewerage and plumbing. Price, bound in cloth, \$7.50.

## ABERRANT PORTIONS OF THE MÜLLERIAN DUCT FOUND IN AN OVARY.\*

BY WM. WOOD RUSSELL, M. D., *Associate in Gynecology, Johns Hopkins University, Baltimore.*

The specimen which I present this evening is of extreme interest, because it brings up the much-disputed question as to the derivation of the gland-like spaces as well as the papillary and adenomatous tumors of the ovary: whether they take origin from the germinal epithelium, the remains of the Wolffian body, or the Graafian follicle. In the light of our present knowledge of the development of the urogenital system I am actuated, from the study of this specimen, to add another possibility to these just mentioned.

Accepting the studies of Nagel, that the epithelial elements of the Müllerian duct are derived from the germinal epithelium, as correct, I believe we are able to explain the condition found in this instance as due to an anomalous point of development of portions of the Müllerian duct in the germinal epithelium.

The ovary from which the slides were taken was removed January 2d, 1897, during an operation for a cystic adenocarcinoma of the left ovary.

As is the custom after removing a pelvic tumor, the other pelvic organs were inspected, and in this case I found the opposite ovary enveloped in adhesions on the posterior surface of the broad ligament, while the tube was free and patent. The patient having reached the age of the natural menopause, I decided that it was best to remove it, to relieve her of any future anxiety. Nothing unusual was noticed about the ovary, it being of normal size, the outer pole cystic and the surface covered with shreds of adhesions. The uterus was also normal.

The specimens were hardened in Müller's fluid, cut, and stained with hæmatoxylin and eosin.

On microscopic study of the right ovary, we were astonished to find areas which were an exact prototype of the uterine glands and interglandular connective tissue. Further search through serial sections of the remainder of the ovary revealed similar foci scattered throughout the specimen in which the glands and interglandular connective tissue were in many places surrounded by bundles of non-striated muscle. On the posterior surface at a considerable distance from the hilum, was a shallow groove partly filled with glands of the uterine type, opening on the abdominal side. The epithelium covering this group gradually merged into a single layer of low columnar cells and at the edges of the groove spread out over the surface for a short distance as the germinal epithelium.

A large corpus luteum which occupied the outer pole was two-thirds surrounded by a narrow space lined with columnar epithelium. In places this epithelial lining dipped down into the tissues beneath, and formed gland-like structures.

In the substance of the ovary were spaces lined with columnar epithelium in places having distinct cilia. Beneath this was a band of glands imbedded in connective tissue. The glands were arranged as in the normal uterine mucous

membrane and opened into the spaces, their epithelium being continuous with its lining membrane. The interglandular connective tissue was composed of small cells with darkly staining oval and round nuclei almost completely filling the cell body, in fact identical with that found in the uterus.

Beneath the spaces were bundles of muscle, arranged more or less concentrically, with strands running off into the ovarian tissue.

Leucocytes and red-blood corpuscles with indistinct outlines partly filled the spaces. The whole formed an exact reproduction of a portion of the uterine mucous membrane and muscle. The arrangement of these structures gave the impression that they were a continuous system from the groove (Plate I, Fig. 3) on the posterior surface to a cystic space in the anterior face (Plate II, Fig. 2).

The ovary contained many corpora fibrosa and a few Graafian follicles in various stages of development; some of which were cystic. In many places throughout the specimen were foci of pigment in the ovarian tissue, in some of which the shrunken forms of red-blood corpuscles could be seen, being evidently the remains of hæmorrhage. The hilum did not contain any of these glandular structures, but appeared normal, except for a sclerosis of the vessels.

Williams' remarks, concerning the origin of epithelial elements, in the ovary: "Indeed, the number of theories advanced has been limited only by the number of structures entering into the composition of the ovary." I will not attempt, therefore, to review the subject, but state briefly the most important of the theories.

*Germinal Epithelium.*—Anomalies of growth in the germinal epithelium have, in many instances, been held responsible for these structures.

Waldeyer's<sup>1</sup> conception of the origin of the Graafian follicle, from nests of cells forming in the germinal epithelium and then being isolated from the other cells by connective tissue penetrating the area from below and surrounding these nests, is now accepted by, practically, all recent observers.

The Valentine-Pfuger theory which ascribed the origin of the Graafian follicle to specialized tubes, the so-called Pfuger's ducts, formed by the germinal epithelium dipping down into the substance of the ovary has therefore lost its significance, and the hypothesis dependent on it for an explanation of the origin of epithelial tumors of the ovary should be discarded.

In a later investigation Waldeyer decided that these gland-like spaces were accidental inclusions of germinal epithelium occurring either in fetal or adult life.

Marchand<sup>2</sup> was the first to call attention to the close relationship between the germinal epithelium and the epithelium of the Fallopian tube, stating that primarily they have a common point of origin. He believed that the epithelium of the tube could extend out over the surface of the ovary, and by penetrating the stroma of the ovary produce tubules similar to

\* Read before the Johns Hopkins Medical Society, April 4, 1898.



Pflüger ducts. From these, he argued, cysts might arise, and he further remarks on the histological resemblance between the mucous membrane of the tube and papillary tumors of the ovary.

Williams also traced a small papillary cyst in the ovary to a prolongation of the epithelium from the tubo-ovarian fimbria.

Shortly after the appearance of Marchand's paper, DeSinty and Malassez\* described some interesting specimens in which they discovered tubes lined with epithelium running in various directions through the ovary and opening on the free surface, the epithelium at these places being continuous with the germinal epithelium. They considered these structures as analogous to Pflüger's duct, but formed in adult life. Since then, these observations have been frequently confirmed.

Nagel,\* Gusserow and Eberth believe that the germinal epithelium may be incited to papillary growths by inflammatory reaction about the ovary, Nagel having seen the germinal epithelium preserved beneath adhesions.

*Graafian Follicle.*—From the beginning of the scientific investigation of the genesis of ovarian tumors the Graafian follicle has played a prominent rôle. Frommel\*, in 1890, formulated a hypothesis, but was unable to prove it by actual finding. He had found a superficial papilloma of the ovary, which undoubtedly sprung from the germinal epithelium, and believed from this that the membrana granulosa of the Graafian follicle, being a derivative of the germinal epithelium, could produce similar growth.

Williams in 1894 found in what he considered a dilated Graafian follicle a papillary outgrowth from the membrana granulosa. Yet the question is by no means definitely settled that the membrana granulosa is a derivative of the germinal epithelium. Waldeyer's theory undoubtedly explains the manner in which the ovum becomes embedded in the ovarian tissue, but whether the cells lining the follicle are epithelial or connective tissue in origin remains unsolved.

*Wolfian Body.*—The Wolfian body, on account of the proximity to the ovary in the early development of the urogenital system, has been offered by many writers as a probable source of these glandular structures, but of this there is absolutely lacking scientific proof. The possibility that some of the tubules of the primitive kidney may be caught in the germinal epithelium while it is budding out to form the ovary cannot be denied, but I believe that if such an event should occur these tubules would retain their original characteristics and not be transformed to the type of those arising from the Müllerian duct.

*Müller's Duct.*—Recently, Kossman\* has, with great skill, discussed the subject from a new aspect in connection with his work on accessory Fallopian tubes. He insists that all intraligamentary cysts reaching considerable size spring from rudimentary tubes lying in the broad ligament, which he has found to exist in about ten per cent. of women. His arguments which appear most plausible are as follows:

The secreting portion of the primitive kidney, the glomeruli, disappears completely during intra-uterine life and may, therefore, be left out of consideration. The parovarium, paroöphoron and Gartner's duct are simply conducting channels

during fetal life, and their epithelial lining has at no time in their history secretory power. If it had, they would sooner or later all become cystic, as they have no external openings. On the other hand, the mucous membrane of the tube has undoubtedly the power of secretion, and by occlusion of its openings always forms a cystic tumor, hydrosalpinx. He draws a sharp distinction between the embryological germinal epithelium during the formative stage and that of a later period. After the differentiation of the epithelium into its various parts, these specialized parts are entirely distinct in their character and without power of further reproduction. The germinal epithelium, after the developmental stage, remains functionally inactive and exists only as a single layer of epithelial cells covering the surface of the ovary.

All tissues of the body are subject to the rule that after differentiation has once taken place in foetal life, one can never be transformed into another. Further, the papillary growth covered with ciliated cylindrical epithelium has, in this region, its only analogue in the tube. This holds good for the tube, ovary and broad ligament. Those arising in the ovary are from isolated plaques of epithelium of the fimbriated end of the tube which have become differentiated from the germinal epithelium at an abnormal point.

At this point it is important to understand the present views in reference to the origin of the epithelium of the Müllerian duct.

There has been a wide diversity of opinion on the subject, and several theories advanced, some believing that it is derived solely from the Wolfian duct, others from a specialized portion of the peritoneum, and yet others, partly from the germinal epithelium and partly from the epithelium of the Wolfian duct. To Waldeyer belongs the credit of first calling attention to the formation of the groove in the germinal epithelium which later becomes the Müllerian duct. Its significance, though, was not fully estimated until the appearance of Nagel's\* work, who substantiated Waldeyer's observation, and further discovered that the germinal epithelium at the point contained the so-called sexual cells which are the progenitors of the ova in the females. In following the further development of the Müllerian duct, he finds that the primitive groove closes at its distal end, forming a blind tube which sinks into the Wolfian body and pushes backward beside the Wolfian duct, but remains throughout absolutely independent of it.

The conclusion to be drawn from this is, that the epithelium of the Müllerian duct is exclusively derived from true germinal epithelium.

If we accept this view of Nagel it is not difficult to conceive that a portion of germinal epithelium which forms the ovary should, at times, attempt to produce structure which its function elsewhere calls upon it to do.

Such an accident may be represented by simple tubes or spaces lined with ciliated columnar epithelium of the tube, or villous and papillary growth analogous to the mucous membrane of the tube or even the more complicated structure of the uterus, glands, interglandular connective tissue and muscle.

In the specimen which I have described there is a collection



of glands in a groove on the surface of the ovary. The epithelium covering them is continuous with a single layer of columnar cells at the margin of the groove and extends a short distance over the surrounding surface. Thus we have direct proof that the germinal epithelium is capable of producing glands analogous to those of the uterine mucosa.

Burkhard<sup>10</sup> has described a very interesting small multilocular cyst of the ovary in which was found non-striated muscle and glands. On the surface of the tumor were several nodules made up of involuntary muscle, throughout which were scattered small round cysts lined with ciliated epithelium. He ascribes these structures to the germinal epithelium, but does not associate them with the Müllerian duct. He has neglected to describe minutely the character of the connective tissue immediately surrounding these structures and I am unable, therefore, to determine if the specimen resembles the above in that particular.

Since writing the above, von Franque<sup>11</sup> has published the preliminary report of an ovary which apparently confirms the Wolfian body theory. His remarks are so brief that one is not justified in criticism, but it would seem that he has in his case positive evidence that the parovarial tubules can, as we have already suggested, enter the ovary through the hilum and produce these glandular formations.

I shall be able in a short time to produce further evidence that this theory holds good for the origin of epithelial tumors of the ovary, as I have discovered in the wall of the cyst of the opposite ovary structures identical with those described.

#### DISCUSSION.

DR. BARKER.—The case is interesting to anatomists on account of its relation to the topic of the origin of the sexual ducts in man. In the development of the sexual organs of higher animals a curious transformation of organs used in other animals for very different purposes appears to have taken place. A comparison of the three pairs of kidneys of lower forms, the front, middle and hind pairs, and their special ducts with the structures met with in higher forms show that the ducts from the front pair correspond to Müller's ducts, those from the second pair to the Wolfian ducts, and those from the third pair to the ureters. The front pair of kidneys (Pronephros) never appear in human embryos, and yet strangely enough their ducts do appear. The middle pair of kidneys (Mesonephros) are represented in the human being by the Wolfian bodies; the third pair (Metanephros) are the functional kidneys of human beings.

Now as the need for more complicated sexual organs arose, it appears that the two front pairs of kidneys and their ducts were utilized to build them, those of the front pair being used for the organs of the female, and those of the middle pair for the genital organs of the male. The Müllerian ducts of the two sides ordinarily fuse in their lower two-thirds to form the uterus and vagina. The upper third on each side corresponds to the Fallopian tube of that side. In the male, the part corresponding to the Fallopian tube disappears; that corresponding to the uterus forms the *utricleus prostaticus*, the lower part disappearing entirely. In the female the Wolfian body,

or middle kidney, is embedded as the paroöphoron in the hilus ovarii, the little ducts going to form the paroovarium and the lower portion constituting Gartner's duct or the ductus epoöphori longitudinalis, a little tube which runs parallel to the vagina. In the male the Wolfian body (Mesonephros) is represented by the paradidymis or organ of Giralde's. The Wolfian duct gives rise to the ductuli efferentes testis, the epididymis, the ductus deferens, the ductus ejaculatorius and to the vesicula seminalis with its ductus excretorius. It seems likely that Skene's tubules in the urethra of the female are derived from the Wolfian duct in which event they might, perhaps, be fairly looked upon as the structures corresponding to the seminal vesicles and ejaculatory duct of the male.

The study of the embryology of these structures is essential for a clear understanding of the normal anatomy, and especially for the comprehension of the deviations from the normal mode of development met with in cases of hermaphroditism, etc. The pathology of various conditions first becomes luminous when the developmental relations are considered. The case which Dr. Russell has just reported would be extremely difficult to interpret had not the proximity of Müller's duct to the germ-cell masses been well established.

The case he has so carefully described is an extremely rare one, indeed I believe it is the only one on record. It is especially interesting that a portion corresponding to the uterus should be that which appears imbedded in the ovary.

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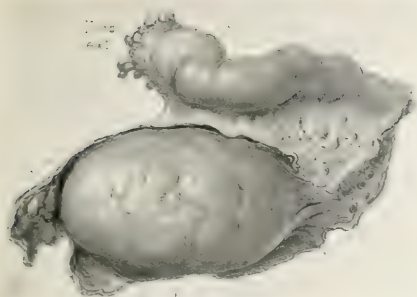


FIG. 1. Natural size, showing normal tube with patent fimbriated extremity. Ovary posterior view with portion of adventitious capsule.

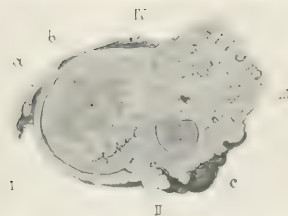


FIG. 2.—Longitudinal section through centre of ovary.

I. Space partially surrounding corpus luteum (*b*) lined with epithelium, in which on lower side glands were present.

II. Groove, at bottom of which is a wedge of tissue made up of glands and interglandular tissue covered with a single layer of epithelium continuous with that on the surface.

III. Space lined with columnar epithelium and surrounded by mucous membrane of the uterine type and non-striped muscle.

IV. Point beneath adhesions, (*a*) where germinal epithelium was preserved. (*c*) Cystic follicle.

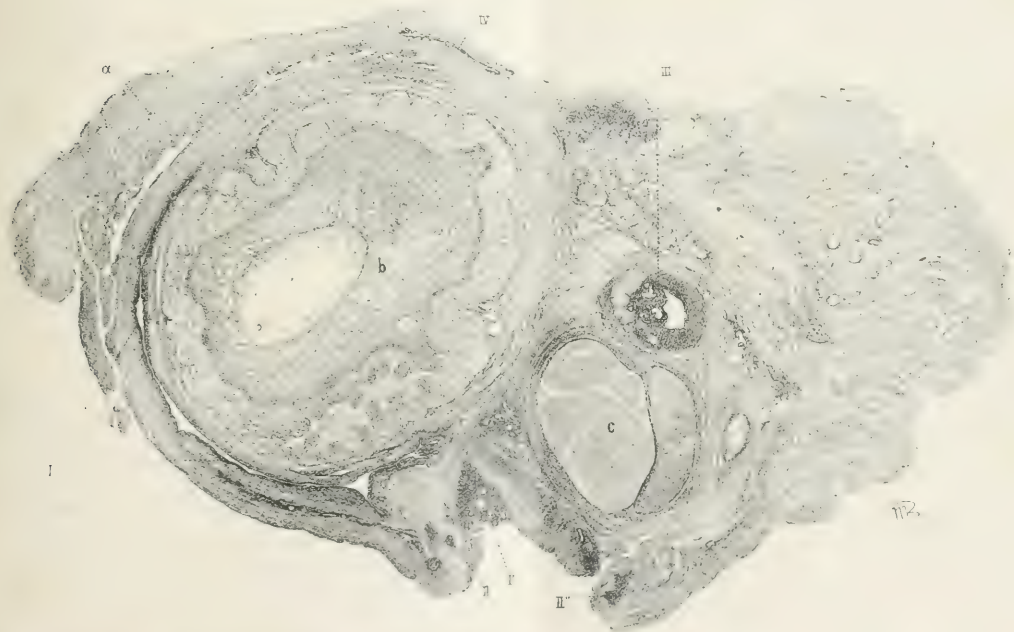


FIG. 3.—Longitudinal section through ovary and hilum posterior face. (Magnified four times.)

I. Corresponds to I, Fig. 2. In the lining of the space toward the centre of the ovary is seen distinct gland formation.

II. Corresponds to II, Fig. 2, in which the glands can be plainly seen, some of which are cystic.

II'-II''. Groups of glands near surface of ovary surrounded by distinct stratum of uterine type.

III. Space surrounded by mucous membrane and muscle, at least part of the uterine mucosa and muscle, some of the glands cystic, corresponds to III, Fig. 2.

IV. Germinal epithelium in adhesions. (*a*) Adhesions formed by union of ovary to uterus. (*b*) Corpus luteum. (*c*) Cystic Graafian follicle. Right corner of section represents vascular zone of hilum, entirely free from glands.

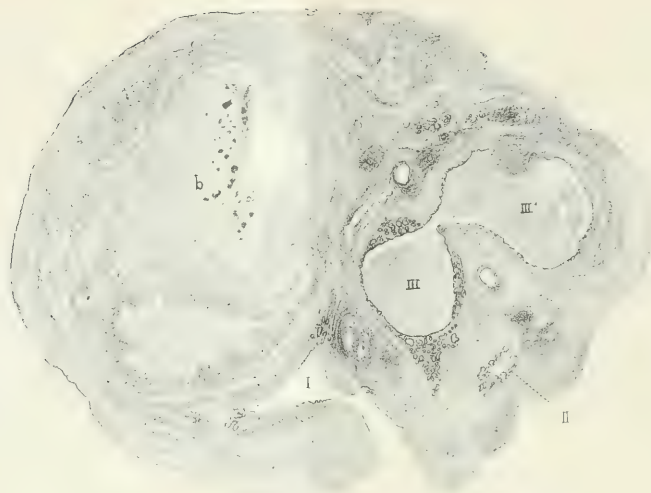


FIG. 1.—Longitudinal section through centre of ovary without hilum. (Magnified four times.)

I. Groove described in Plate I.

II. Glands surrounding space near the capsule with stroma.

III-III'. Two large spaces in centre of ovary communicating by a narrow strait.

III. Space completely surrounded by mucous membrane and muscle, and lined with columnar epithelium, which is in places ciliated. The membrane becomes thinner as it approaches the strait, and just as it passes over into space III', becomes a single layer of columnar epithelium.

Space III'. The cells forming its lining become gradually lower, merging first into cuboidal, and at the furthest point from the strait are flat. The knot-like projection in upper border of III' is an organizing blood clot, covered at the base by flat cells. *b* Corpus luteum.

The contents of the spaces are made up of partly disintegrated red-blood corpuscles, leucocytes and granular debris.

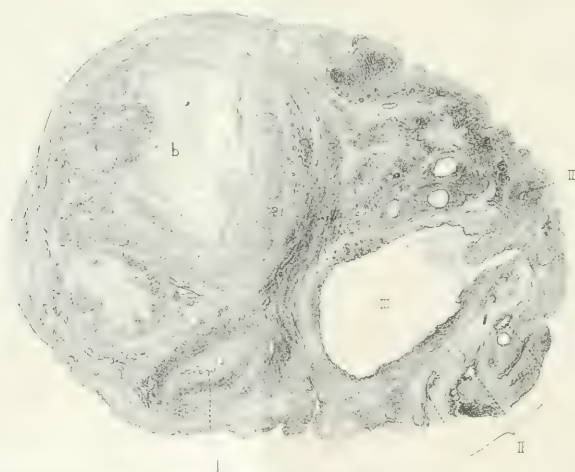


FIG. 2.—Longitudinal section through anterior face of ovary. (Magnified four times.)

I. Space in lower border of parenchyma of ovary lined with columnar epithelium, in which, at places, is distinct gland formation.

II. Groups of glands in and beneath capsule.

III. Large cystic space surrounded in greater part by connective tissue of the type found in the uterine mucosa. Most perfect glands along the left upper border.

III'. Group of glands. *b*. Corpus luteum seen in other section.





- (a) Blood corpuscles forming part of contents of space
- (b) Typical uterine glands and stroma, two of the glands opening into space, and whose epithelial lining is continuous with that of the space.
- (c) Non-striated muscle resembling that of the uterine wall.
- (d) Normal ovarian tissue containing Graafian follicles in various stages of development and corpora fibrosa.

Portion of wall surrounding space III, Plate II, Fig. 1 (magnified 55 times), section through mucous membrane and muscle down into normal ovarian tissue.



## THE CAUSE AND SIGNIFICANCE OF UTERINE HEMORRHAGE IN CASES OF MYOMA UTERI.

A STUDY BASED UPON THE ARTIFICIAL INJECTION OF TEN SPECIMENS OF MYOMA UTERI AND FURTHER VERIFIED BY THE CLINICAL AND PATHOLOGICAL REVIEW OF ONE HUNDRED OTHER CASES.

BY J. G. CLARK, M. D., *Associate in Gynecology in the Johns Hopkins University, late Resident Gynecologist in the Johns Hopkins Hospital.*

Some three or four years ago, on searching through the current medical literature and the generally accepted text-books for an explanation of the hemorrhage so frequently accompanying myoma uteri, I was surprised to find very little unanimity of opinion upon the subject. Many writers merely state that hemorrhage is a frequent clinical symptom of these tumors, but attempt no explanation of this phenomenon. Others make the more definite statement that hemorrhage is less frequent the further the tumor is situated from the uterine mucosa, while still others quote the explanations of Wyder, v. Campe, Schmal and Semb, to which I shall refer later. With a view therefore of throwing more light upon this subject or at least of confirming the results of some one of the preceding investigators, I began the study of the macroscopic appearances in conjunction with a close analysis of the clinical history of specimens of myomata removed by hysterectomy. The observations, however, upon which I have relied most for my conclusions have been made in a series of ten artificial injections of the principal varieties of tumors. In my early study of these cases the fact had frequently impressed itself upon me that the mere size of the tumor bears absolutely no relationship to the amount of hemorrhage, for in some instances tumors as large as the pregnant uterus at term have been accompanied at no period of their development by this symptom, while, on the other hand, tumors so small as not to be perceptible to the patient have induced such excessive bleeding as to require operative treatment most urgently. Again the frequency of hemorrhage accompanying the submucous tumors and its absence in the subperitoneal types was self-evident.

In view of these general observations and the fact that on section myomatous tumors as a rule show a very poor vascularization, the explanation of the hemorrhage did not appear at first sight to be due to the tumor *per se*, but to mechanical disturbances induced in the uterine circulation through its presence. Myomatous tumors, as is well known, present a most remarkable morphological diversity; their size, form and position being subject to the widest variation from any fixed standard of development, due not to deviations from their primitive histological basis, for within narrow limits they conform more or less closely to a uniform microscopical type, but to variations in their gross anatomy. For clinical purposes these tumors are classified according to their location into subperitoneal, interstitial and submucous varieties, but comparatively seldom do we find a given specimen composed solely of any one of these types, for they are usually scattered indiscriminately throughout the uterine wall, some appearing as subperitoneal bosses, others as rounded nodules completely surrounded by uterine muscle, while still others project into the uterine cavity as submucous tumors.

Besides this multiplicity frequently single tumors are observed which partake more or less of the characteristics of all the other types; thus an interstitial tumor may project into the uterine cavity and besides present an equally extensive surface beneath the peritoneum.

In view of the heterogeneous growth of these tumors it would appear evident that any rule governing the hemorrhage which has a mechanical basis for its support must present many variations. The atypical bleeding in cases of myoma uteri may manifest itself therefore as an increase in the catamenial flow or as profuse and irregular inter-menstrual hemorrhages. Were the tumor itself to possess inherent characteristics which induce hemorrhage it goes without saying that in all cases this symptom would occur.

The splendid collection of myomata in the Gynecological Department of the Johns Hopkins Hospital contains one specimen which illustrates especially well the fallacy of the latter hypothesis. The tumor, a picture of which has already appeared in Kelly's *Operative Gynecology*, Vol. II, opposite p. 382, is a large angiomatous myoma, occupying the wall of the uterus but not impinging upon the mucosa. Notwithstanding this excessive vascularization the patient did not suffer from hemorrhage and came to operation simply on account of the steady increase in the size of the tumor.

Accepting as an axiom that "to determine the abnormal one must know the normal," it appeared to me absolutely essential to ascertain first the normal scheme of the uterine circulation before attempting to arrive at any conclusion concerning the changes induced in it by the growth of myomatous tumors. The following brief consideration of this subject will therefore not be out of place, for in addition to rendering an explanation of the atypical hemorrhages occurring in cases of myoma uteri easier, it also demonstrates the fact that our preconceived ideas of the vascularization of the uterus drawn from text-books in anatomy and gynecology are in certain details fallacious.

## THE NORMAL CIRCULATION OF THE UTERUS.

In beginning the experimental injections of the uterus, I considered it essential to define the areas supplied by the four arteries (two ovarian and two uterine) terminating in the uterus.

The most commonly copied picture of the circulation is that of Hart and Barbour (Gray's Anatomy), which represents the uterine and ovarian arteries as a thick tortuous communicating system lateral to the uterine walls, giving off branches which in turn quickly break up into tiny vessels terminating in a fine capillary anastomosis in the median line of the uterus. From this cut as well as from the descriptions by the majority of writers it would appear that not only is there a



poorly vascularized median line, but that there is little if any commingling of blood from the two sides except through this capillary anastomosis.

This idea, as I shall show, may be demonstrated as erroneous by artificial injections of the uterus. In my first injection experiments I employed an aqueous solution of Prussian blue. Cannulae were inserted into the two uterine and two ovarian arteries, and the injection was begun by forcing the fluid first into the uterine artery of one side. Before even the peritoneal covering of the uterus was darkened the injection fluid had rushed through the lateral communication between the ovarian and uterine artery, and began to flow from the ovarian artery, thus showing that there is absolutely no bar to the reflux of blood from the uterine to the ovarian artery or vice versa, and that under normal conditions of the circulation the cardiac force transmitted through the uterine and ovarian vessels must act conjointly in forcing the blood from the utero-ovarian circle lateral to the uterus into their ultimate terminals. Another phenomenon, which was especially noteworthy, was the rapid crossing over of the injection fluid to the opposite side of the uterus, where it escaped, not from the vein, *but from the uterine artery*, and only after the latter was clamped did the fluid begin to escape from the efferent vessels. From the initial point of injection the entire uterus was deeply colored with the blue solution, demonstrating the existence of a very easy communication between the myriads of vessels ramifying throughout the uterus. Whether this communication was established through capillaries or whether through the direct anastomosis of larger vessels, I was not able to determine from this experiment; but still clinging to the idea set forth in the text-books I was disposed to accept the first hypothesis.

Still with the intention of defining separate areas supplied by each of the vessels I resorted to the use of a granular injection mass, consisting of ultramarine blue suspended in 10 per cent. gelatine, knowing that the granules would only pass down to the capillary system but not through it. Upon attempting this I was surprised to find that the same phenomena occurred as in the first experiment, demonstrating beyond doubt that there is, in addition to the usual capillary communication, a direct arterial anastomosis between the intra-uterine vessels, which is not an insignificant one, but plays a most important part in the circulation of the uterus.

When I related the phenomena noticed in my first injections, conducted in the anatomical laboratory of the Johns Hopkins University, to Prof. Spalteholz of the University of Leipzig, I found him disposed to cling to the older opinions and to think that possibly there was some error in my injection technique. Later, however, when making injections of the uterus from which to have pictures drawn for his anatomical atlas, he obtained identical results, and will depict in his forthcoming volume a direct arterial communication between the two lateral utero-ovarian circulations.

When we consider the varying physiological phases through which the uterus passes (the most important of which—the puerperal state—is dependent upon an abundant and unflinching blood-supply), this provision of nature, whereby an easy communication is established between its four arterial sources,

not only through a capillary system like that of other organs, but also through a more direct arterial anastomosis, appears to be absolutely essential. To leave the nutrition of any portion of this important organ to the care of one set of vessels, which might become impaired, would undoubtedly render it liable at any time to serious functional disturbances.

To briefly epitomize the results of my observations on the normal vascularization of the uterus, I would say that it consists of the lateral utero-ovarian anastomosis which give off excessively tortuous secondary branches, some of which penetrate the outer layers of uterine muscle and finally terminate as delicate twigs in the uterine mucosa, while others extend across the uterus and fusing with similar branches from the opposite side form direct arterial communications. From the latter, branches are given off which also penetrate the deeper-lying musculature and terminate in the mucosa. Beyond establishing the fact that there are direct arterial communications besides the usual capillary anastomosis and verifying the main points in the vascular scheme as depicted by others, I have not attempted to go, contenting myself for the present with a macroscopic study of the gross specimens and with the examination by means of a dissecting lens of thick sections cleared in xylol.

I hope to make a further communication upon the exact scheme of the circulation of the uterus at a future date.

#### THE MECHANICAL DISTURBANCES IN THE CIRCULATION IN CASES OF MYOMA UTERI.

From my study of the circulatory changes in uteri, the seat of myomata, I am convinced that the increased menstrual flow and atypical hemorrhages which are so frequently associated with these cases are dependent solely upon mechanical conditions, which induce first, a congestion of the deeper-seated muscular and endometrial vessels and this in turn to an increase or prolongation of the menstrual flow, and second, an actual derangement or disorganization of the vascular systems of the endometrium and of the tumor itself, through which atypical hemorrhages occur, varying in degree from a slight inter-menstrual discharge to a loss of blood so great as to cause the most prostrating or even fatal anaemia.

First, as to the part played by mere venous stasis in the production of the increased menstrual flow.

In its natural history the uterus after puberty passes through its successive menstrual cycles with the attendant sanguineous flow. According to some observers this flow is due to an actual rupture of the capillaries of the endometrium, while others believe that it occurs through a simple diapedesis. The latter view is held by Dr. Cullen, who has reached this conclusion after an extensive study of the endometrium in all of its normal and pathological conditions. According to my own observations I see no reason to doubt this conclusion.

With this well-sustained theory before us as a working basis the explanation of the increased menstrual flow in cases of myoma uteri is comparatively easy. In their early growth these tumors appear as minute whitish bodies lying in the depths of the uterine muscle. In all of my injected specimens, the smallest tumors, some of them not larger than a pea, show a remarkably poor internal vascularization, in comparison with

the surrounding musculature. The tumor apparently starts as a whirl or kink in the fibres of the muscle, and is not, according to my observations, supplied by a central vessel, as stated by some writers, but derives its blood-supply from vessels coursing between the surrounding fibres. This insignificant initial wreath grows into a thick network of encircling vessels which send radiating branches into the interior of the tumor. In the progressive development of the tumor the increase in the blood-supply is not commensurate with that of the tumor, which leaves its center sooner or later more or less isolated from the peripheral source. With the increasing size of the tumor, it follows the simple mechanical law of pushing in the line of least resistance, and accordingly tends to move outward towards the peritoneum, or inward towards the uterine cavity. In case the surrounding resistance is uniform it naturally maintains its intramural position. *Pari passu* with the outward mobilization of the tumor the tendency to a disturbance of the circulation sufficient to create menstrual disorders decreases. Even when the tumor remains as a simple interstitial growth no subjective symptoms relative to the menses are, as a rule, noted. There are, however, some instances where, notwithstanding the fact that the tumor does not encroach upon the mucosa, the menstrual flow may be increased or prolonged, but, so far as my observations go, never to the extent of becoming irregular and profuse. This condition, I am convinced, may be explained upon a mechanical basis. In the quiescent state of the uterus during the inter-menstrual period, the vascular system around the interstitial tumor is only partially filled; but let this same system become distended to turgescence under the menstrual influence, and it goes without saying that the force exerted by the congested and contracting uterine walls against the more or less dense fibro-muscular tumor, which remains practically unchanged in its resistance, will retard the exit flow from the deeper veins lying in proximity to the uterine mucosa. As a result of this venous stasis, increased extravasation or diapedesis of blood occurs into the uterine cavity. If there is a multi-nodular conglomeration of tumors the crowding together of these resistant bodies may also tend very greatly to inhibit the recurrent flow between them, producing even a greater internal congestion than in the first instance.

Here, just as in other tissues, the arteries, on account of the greater thickness of their elastic walls and their constant pulsations, tend to overcome the surrounding pressure and maintain their patulous condition, whereas the veins, which are in many instances little less than flaccid venous channels, are subject to compression upon the resistant tumors. A simple mechanical reproduction of this condition may be made by grasping in the palm of the hand a hard ball over which is placed a soft rubber tube with water flowing through it. A light pressure, sufficient to retain the ball in the hand, will not retard the flow through the tube, but a stronger grasp at once partially or completely checks the flow. In the application of this mechanical principle to cases of myomata, two sets of tubes coursing over the hard ball represented by the tumor must be considered, one of which, the arteries, as already stated, are elastic and pulsating, while the other, the

veins, are mere passive channels. In the increasing congestion of the uterus incident to the menstrual cycle, the arteries tend to resist the surrounding pressure and maintain their flow, whereas the veins may become compressed against the tumor, and as a result a venous stasis in the deeper-lying tissue of the uterus occurs with a consequent increase and prolongation of the menstrual flux.

With the passing of the menstrual cycle the arteries return to a passive condition when the veins again become sufficiently patulous to transmit the blood to the large efferent trunks, and the metrostaxis ceases only to be renewed again in the succeeding period as a prolonged but otherwise normal flow. To prevent misconception as to the frequency of this occurrence I would especially emphasize the clinical fact, that in the majority of cases of interstitial and subperitoneal tumors, even increased menstruation does not occur, which is explained no doubt upon the ground of a compensatory vascular adaptability.

While the blood-vessels in close proximity to the tumor may partially be blocked the anastomoses within the uterus are so perfect as to leave patulous many other equally easy avenues of escape for the venous blood. Therefore, even a decided increase, without further derangement in the menstrual flow, is nearer an exception than a rule, unless there is some impingement of the interstitial tumor upon the endometrium.

With the encroachment, however, of the tumor upon the uterine cavity a second and most weighty cause for the hemorrhage comes into action. As depicted in the normal scheme of the uterine circulation the vessels which supply the endometrium reach this point by penetrating the inner muscular coat of the uterus, where they freely anastomose with each other and finally terminate as delicate twigs surrounding the glands of the mucosa. Until this scheme is very much deranged or disorganized by the advancing myoma usually no serious disturbance in the menses, as stated above, will occur. When the tumor, however, reaches the mucosa the menses tend to become free and prolonged, due to a thinning of the mucosa and a coincident degeneration of the vessels which renders the usual diapedesis much easier or gives rise to an escape of blood through actual rupture of the capillaries. In this connection I may say that, according to the histological observations of my colleague, Dr. Cullen, the vessels of the endometrium are very resistant, and that in the earlier stage of encroachment of the tumor the increased flow occurs by diapedesis rather than by actual rupture. At first only the terminal twigs of the endometrium are involved, but later, as the tumor advances and the tension is increased the mucosa through gradual erosion assumes a white, glazed, parchment-like appearance, showing the deeper-lying vessels of the capsule of the myoma.

At this stage the mucosa may be said to have disappeared from the dome-like prominence of the tumor; but further back towards the base where the tension is less and the process of erosion has not occurred, a vascular halo, formed by the vessels of the mucosa, is usually seen. Often a cup-like depression is made by the advancing tumor in the opposite uterine wall in which one finds the vessels exposed in a similar way. From this endometrial zone I have seen occur in some



of my injection experiments the most active oozing. In the further expulsion of the tumor the vessels undergo actual necrosis along with the tumor, which renders them brittle and more liable to hemorrhage through extensive ruptures.

The occurrence of large irregular inter-menstrual hemorrhages may be taken therefore as an almost invariable indication of the development of a more or less extensive submucous tumor. When the tumor has reached the point where its overlying mucosa has entirely disappeared the hemorrhage may become well-nigh constant, appearing as a continuous oozing, which is especially aggravated during the menstrual epoch. Should the case be allowed to follow its own course without operative intervention, the tumor may be expelled completely with subsequent restoration of the patient to health, or it may become the seat of an infection which terminates the patient's life; or finally through the profound anaemia produced by the hemorrhage death may occur either through exhaustion or from a terminal infection.

#### ANALYSIS OF THE CLINICAL AND PATHOLOGICAL RECORDS OF 100 CASES.

In order to verify and further sustain the conclusions drawn from my experimental study, to ascertain whether there are frequent or wide variations from them, I have analyzed as closely as possible the clinical and pathological reports of 100 other cases. The clinical symptoms were taken largely from abstracts made by Dr. Brown from cases operated upon in the Gynecological Department of the Johns Hopkins Hospital, while the pathological reports were abstracted from records largely made by Drs. Cullen and Herdon. Excepting those atypical cases of myoma, such as the adeno-myoma-diffusum benignum (Cullen) and those in which there is a coincident infection, from ordinary pyogenic organisms or from tubercle bacilli or where there exists a coincident association with carcinoma, I have found a surprisingly small variation. For purposes of analysis I have first tabulated the clinical symptoms after which the pathological reports have been appended. As these tables are too voluminous for publication I have endeavored to embody the results of this analysis in the form of schematized drawings, hoping in this way to make these statistics more available for study than were they brought together in the ordinary tabulated form.

Of the hundred cases, I have first classified those which conform to the simple types of tumors (subperitoneal, interstitial and submucous), but as these comprise only about one-third of the total number, the remaining showing combinations of the three, I have placed them under the two following headings: Combined interstitial and subperitoneal, and combined interstitial and submucous tumors. In the latter group several cases have also presented subperitoneal tumors, but as they practically play no part in the production of hemorrhage I have grouped them all under the one heading.

#### SCHEMATIC DRAWINGS OF 100 CASES OF MYOMA UTERI.

(See Plates.)

This analysis shows beyond doubt that the clinical statement concerning hemorrhage in myoma uteri made by some authors is based upon accurate observations.

Dudley,\* of Chicago, has stated this in such a concise and clear way that I take pleasure in quoting it. He says: "The degree of hemorrhage depends upon the location of the tumors relative to the endometrium and the peritoneum.

The closer its relations to the uterine mucosa, the greater the hemorrhage; the nearer to the peritoneum the less the hemorrhage; hence menorrhagia is almost invariable with the submucous variety, less severe but very common with the intramural, and usually slight or absent with the subperitoneal.

The pedunculated submucous and the pedunculated subperitoneal myomata stand at the two extremes, the former producing the greater hemorrhage, the latter none at all."

#### THE SURGICAL ASPECT OF THIS STUDY.

In criticism of the remarks following the appended reports of cases it may be said that an ante-operative judgment sufficient to render definite advice, as to the adoption of a radical or conservative line of treatment, is not possible, because data sufficient to support such a judgment cannot be obtained from the anamnesis or from our usual methods of examination. Admitting that this to a certain extent is true, I am nevertheless convinced that the close study of the symptoms in conjunction with a careful examination of these cases will usually yield very definite or at least strongly significant suggestions which will lead to a more complete diagnosis than is usually made.

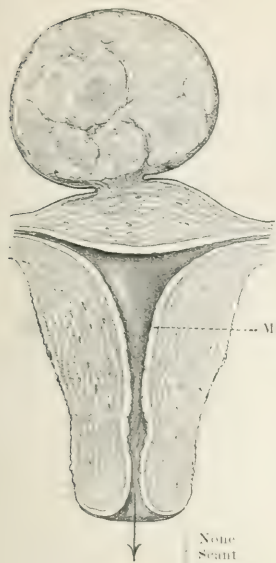
The simple diagnosis of a myomatous tumor of the uterus with a subsequent hysterectomy is no longer a difficult matter, but the careful exclusion of the large number of cases from the great general class which, until the last two or three years, have been subjected to the wholesale extirpation of the uterus is a matter requiring accurate discrimination and good surgical judgment. Besides the superior judgment required for the selection of these cases, higher operative measures are brought into play, for it certainly requires more skill to remove the many tumors which one so often finds studding over the surface of the uterus, distending its walls or projecting into its cavity, and to repair through a plastic operation the resultant defects, than to perform a simple hysterectomy. The immediate results and splendid progress of these cases subsequent to operation are the strongest arguments in favor of conservatism.

The removal of either ovaries or uterus in young women, in the majority of whom the maternal instincts are more or less strongly implanted, is to my mind one of the most serious surgical procedures, and always to be avoided when possible, not because of the direct influence exercised by the presence of these organs on the womanly characteristics, but because of the depressing mental influences which follow in some instances the realization by the patient that she is sterile and will remain so to the end of her life. To say, therefore, that a simple or multiple myomectomy with the preservation of the ovaries and tubes is a great improvement over total hysterectomy-salpingo-oophorectomy is not a subject for argument. It is a self-evident truth based upon the principle of preservation,

\* Diseases of Women, 1898.



# 6. SUBPERITONEAL.

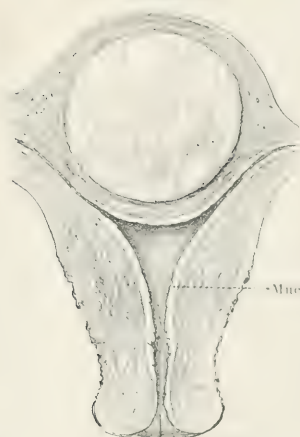


Mucosa { Normal 4  
Thickened 2  
Atrophied 0

Menstrual Flow

None 1  
Scant 2  
Normal 3  
Profuse 0  
Irreg. and Profuse 0  
Continuous 0  
Painful { No 6  
Yes 0

# 21. INTERSTITIAL.



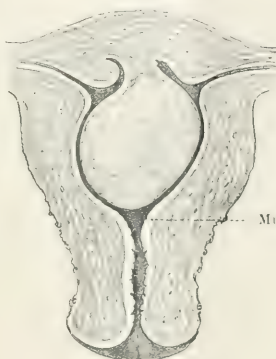
Mucosa

Normal 9  
Thickened 4  
Localized 0  
Atrophied 8

Menstrual Flow

None 1  
Scant 1  
Normal 11  
Profuse 5  
Irreg. and Profuse 3  
Continuous 0  
Painful { No 8  
Yes 9

# 4. SUBLIGATES.

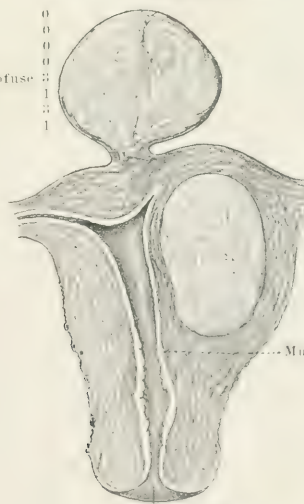


Mucosa { Normal 0  
Thickened 0  
Atrophied 4

Menstrual Flow

None 0  
Scant 0  
Normal 0  
Profuse 0  
Irreg. and Profuse 3  
Continuous 1  
Painful { No 3  
Yes 1

# 42. COMBINED SUBPERITONEAL AND INTERSTITIAL.



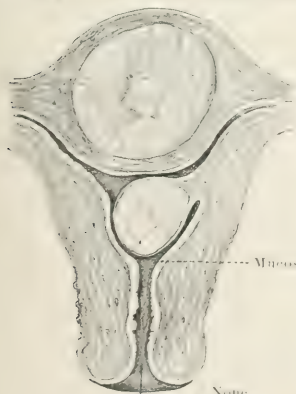
Mucosa

Normal 20  
Thickened 10  
Atrophied 12

Menstrual Flow

None 2  
Scant 4  
Normal 22  
Profuse 6  
Irreg. and Profuse 4  
Continuous 1  
Painful { No 21  
Yes 18

# 27. COMBINED INTERSTITIAL AND SUBLIGATES.



Mucosa { Normal 1  
Thickened 1  
Atrophied 25

Menstrual Flow

None 0  
Scant 0  
Normal 4  
Profuse 10  
Irreg. and Profuse 10  
Continuous 3  
Painful { No 2  
Yes 14

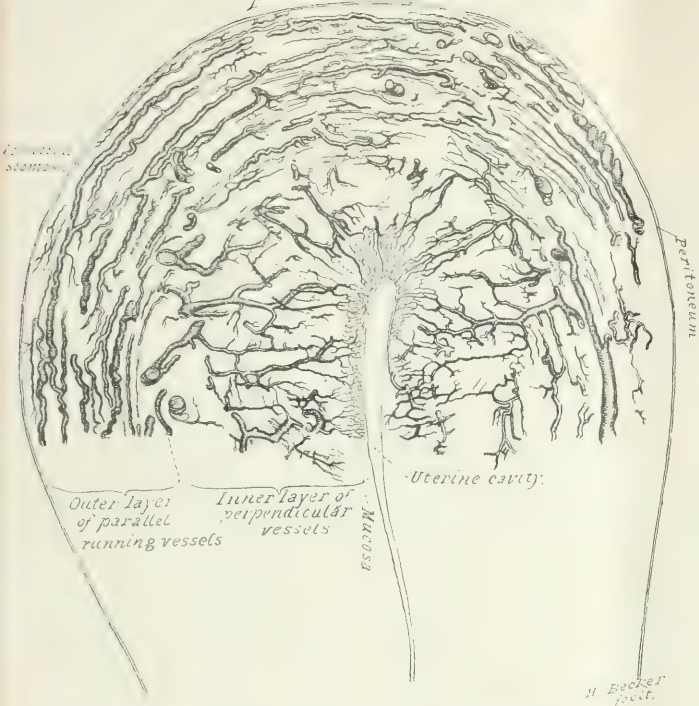


FIG. 1.—Sagittal section of uterus showing the scheme of the arterial distribution. The parallel vessels of the external muscular layer freely anastomose among themselves. From the innermost arteries branches are given off at right angles which penetrate the inner muscular layer, supplying it with numerous anastomosing nutrient vessels, and finally terminate in a rich capillary supply to the endometrium.

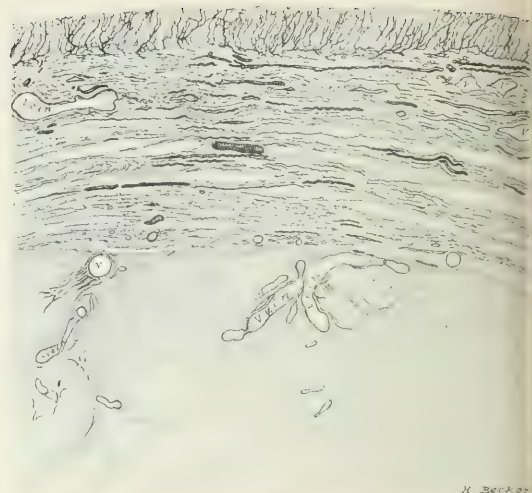


FIG. 2.—Injected specimen of interstitial myoma, showing derangement of vascular scheme. The perpendicular vessels noted in the normal scheme have here assumed a parallel course through the encroachment of the myomatous tumor. The endometrial twigs, instead of being merely the straight terminals of the perpendicular branches, are here given off at right angles. During the menstrual congestion the twigs naturally become more congested, through purely mechanical conditions, than in the normal state, consequently an increased diapedesis occurs. The large venous channels upon the surface of the myoma, which attention has been called in the text, are also well shown.

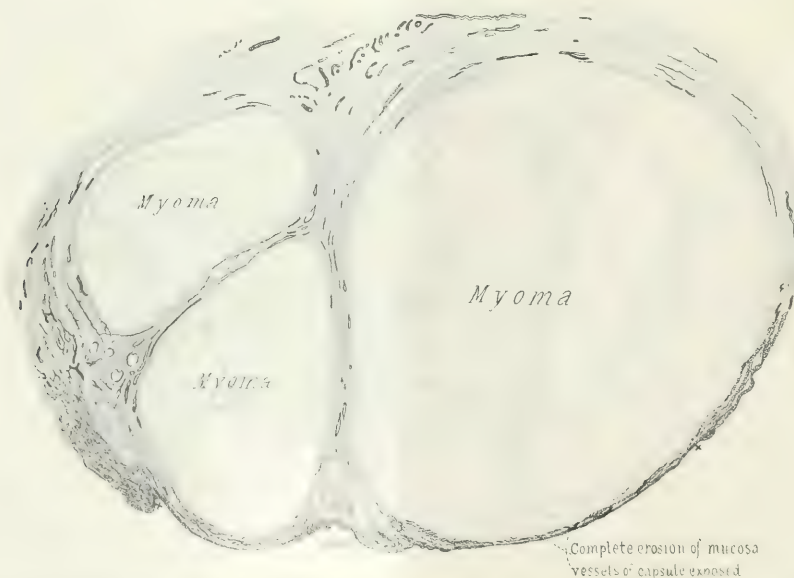


FIG. 3.—Uterine wall containing three interstitial myomata, which have so far encroached upon the uterine cavity as to cause almost complete erosion over the larger and considerable lower tumor. The mucosa is greatly thickened, edematous and congested. The uterine cavity is slightly impeded and the reflex very greatly enlarged. The mucosa over the large tumor was so far eroded that the vessels of the capsule were exposed and subject to rupture either through simple pathological or traumatic influences.

rather than that of sacrifice, which in the end leads to a restoration rather than an abrogation of function. I feel assured when the combined statistics of the best surgeons of the world have been brought together after the general adoption of these revived principles, that those on conservative myomectomy will present a much more gratifying result than those on total hysterectomy.

#### A BRIEF REFERENCE TO THE LITERATURE BEARING UPON THE ETIOLOGY OF HEMORRHAGE IN CASES OF MYOMA UTERI.

The almost unlimited and unclassified literature dealing with the subject of myoma uteri in its various aspects renders well nigh impossible a selection of the special work upon this topic. For this reason, therefore, I must disclaim the thought that this is an exhaustive review, for I have only attempted to give a brief abstract from those investigations which are generally quoted, with the view of calling attention to the most interesting and instructive points previously brought out in this line.

Wyder,\* whose conclusions were drawn from the study of 20 cases, attributed the hemorrhage to endometritis, induced through the presence of the tumor. According to him the thicker the muscle which separates the myoma from the uterine cavity the less frequently will the circulation be changed and the more pronounced becomes the growth of the uterine glands without participation of the interglandular connective tissue. On the other hand, the nearer the tumor approaches the uterine cavity the more frequently occurs the growth of the interglandular connective tissue, which may leave the glands intact or induce complete atrophy.

Concerning the hemorrhage, he says so long as the endometritis which, according to his opinion, is a constant accompaniment of these tumors, is confined solely to the glands and the interglandular tissue remains approximately normal, this symptom will not occur, and it will only arise when both constituents of the endometrium undergo an increase (Ols-hausen's endometritis fungosa), or when the one or the other grows excessively, or finally when in addition to the endometritis glandularis there is also an interstitial inflammation.

As is at once evident, Wyder's views are not tenable, for, as stated by Semb,† the tumor cannot of itself induce an inflammatory process in the endometrium.

In the examination of 23 cases in Leopold's clinics Semb found in many instances absolutely no evidence of endometritis, and in those cases in which an inflammatory process occurred he considered it merely as secondary to the tumor. From his histological examination he concludes that the mucosa undergoes hypertrophy, without preceding inflammation, consisting either of a uniform increase in both the stroma and the glands or the glandular changes may predominate. After reviewing each of his cases he says hemorrhage will not arise, notwithstanding the most marked changes in the endometrium, or increase in the size of the tumor, if the walls of the tumor show no hypertrophy. According to this view therefore the

hemorrhage depends upon hypertrophy of the uterine musculature with accompanying pathological changes in the vessels.

Schmal‡ arrived at the following conclusions concerning the changes in the uterine mucosa from the study of 15 cases: First, in subserous myomata the mucosa may remain normal or become hypertrophied. Second, in interstitial submucous tumors the mucous membrane becomes atrophic over the tumor and hypertrophic opposite the tumor. No opinion is expressed concerning the occurrence of hemorrhage in these cases.

Borissoff,§ from a study of 21 cases of fibro-myomata, reached the following conclusions:

1. In fibro-myomata the mucosa shows a pronounced sclerosis, which in many cases induces a complete atrophy of the mucosa.

2. Glandular endometritis is relatively seldom observed. It occurs more often in combination with interstitial endometritis.

3. The influence of the tumor upon the mucosa depends entirely upon its position in the uterine wall and its size. If the tumor has reached a certain size it induces through mechanical influence a stretching and atrophy of the mucosa.

4. Bleeding from the uterine cavity results from stagnation of blood in the mucosa and occurs mostly *per rhexin* of the vessels which have undergone pathological changes.

5. The inflammatory changes in the mucosa with the congestion and hemorrhage lead to a desquamation of the epithelium.

Schauta,|| at a more recent date, states in his text-book that hemorrhage seldom occurs from the myoma or its capsule; erosions of the covering layers of the tumor may, however, lead rapidly to fatal bleeding from the large sinuses. Changes in the mucous membrane play the principal rôle; of these hypertrophy takes a much less part than the degeneration of the mucosa and its vessels. This degeneration consists in a thinning, necrosis and erosion of the tense mucosa over the tumor as well as changes in the blood-vessels, which lead to the occlusion of some, to the widening of others and to the rendering of the loops of the vessels brittle.

To my mind this is the best concise statement of the subject which I have found, and conforms in general, as do the conclusions of Borissoff, with those which I have reached.

#### CASES ILLUSTRATING MECHANICAL DISTURBANCES IN THE CIRCULATION IN CASES OF MYOMA UTERI.

A brief clinical report of the cases with the description of the injection experiments of the principal types of tumors will, I believe, be of more service in explaining the hemorrhages in these cases than the mere recital of results. I therefore offer no apology for inserting the following report of cases. For the sake of brevity I have reduced my notes to merely the essential points bearing upon the question, divest-

\* Archiv de Tocologie et de Gynécologie, Tome XVIII.

† Inaug. Dis.: "Ueber die Veränderung der Uterus-Schleimhaut bei Fibromyomen in Verbindung mit Uterusblutungen," St. Petersburg.

‡ Lehrbuch der Gesamten Gynäkologie, 1896.

\* Archiv f. Gynaek., Bd. XXIX.

† Archiv f. Gynaek., Bd. XLIII.



ing them so far as possible of irrelevant and unnecessary matter.

**CASE I. Menstrual history.**—Menses occurred first at 14 years, regular, accompanied by cramp-like pains, moderate flow, occasionally dark clotted.

**Description of specimen.**—Uterus converted into a smooth globular mass about the size of that of a three-months pregnant. The surface of the uterus is even and its general form has not undergone very much distortion, notwithstanding the presence of numerous interstitial nodules, which may be felt within the uterine walls. Posteriorly at the cervico-fundal juncture an interstitial tumor has pushed out towards the periphery and appears as a partial subperitoneal growth.

**Injection.**—Fluid carmine and granular blue injection mass. Cannulæ inserted into each ovarian and each uterine artery, the ovaries remaining attached to the tumor.

Injection began in the left uterine artery, when almost immediately the fluid imparted a deep red color to the uterine wall of that side; hardly had this occurred before the mass quickly passed through the uterus at the cervico-fundal juncture and began to flow from both the uterine artery and vein, followed quickly by its escape from the two ovarian vessels, necessitating the clamping of all of them. From this one vessel the entire uterus and Fallopian tubes were injected.

At the completion of the injection from this source, notwithstanding the apparent complete filling of all the vessels of the uterus, each of the three remaining arteries (one uterine and two ovarian) was in turn injected with a blue granular mass, when the same phenomena were repeated so far as the distribution of the injection fluid was concerned. By this time a very small amount of the red gelatine mass was flowing from the cervix, partly from the uterine cavity, mostly however from the severed ends of the small cervical vessels.

**Examination of specimen.**—On section through the uterus in the median line, from the fundus to the cervix, a most interesting picture is presented.

The uterine muscle is of a uniform red color, mottled with many blue points, indicating the branches of the arterial system. In the midst of this deep red ground color numerous paler myomatous nodules are seen, representing the various clinical varieties of these tumors. One interstitial tumor lies in close proximity to the mucosa. In color the myomata stand out in sharp contrast to the uterine wall, for they are universally poorly injected, the degree of vascularization however varying in the different tumors, some appearing of an alabaster-like whiteness and so poorly supplied with blood as to raise the question of how their existence is possible with so little nutrition. Others, however, are better provided with a vascular system. Of these one is especially interesting, for it is made up of two whirls of muscular tissue with a distinct septum between them carrying blood-vessels which send branches off into the adjacent nodules. Every nodule in the uterus appears well surrounded with vessels consisting in some instances of large open-mouthed channels which appear little less than venous sinuses. The peripheral nodules show a marked thinning out of the zone of vessels beneath the peritoneum, the main blood-supply coming from

the vessels deeper within the walls of the uterus. The endometrium is deeply injected with the red gelatine, while numerous blue puncta are seen over the surface, indicating the terminal points of the arterial twigs.

A thin delicate film of red gelatine is spread uniformly over the mucosa, which has evidently oozed from the vessels of the endometrium. So far as visible pathological changes are concerned the endometrium presents nothing significant, being of normal thickness and consistence throughout the uterus, the interstitial nodule not yet having advanced a sufficient distance into the uterus to cause any visible changes.

**Epitome of observations.**—Universal injection of the uterus and tubes from one uterine artery; rich vascularization around and poor vascularization within the tumors; absence of extensive oozing into the uterine cavity, notwithstanding the presence of many intramural myomata; absence of gross pathological changes within the endometrium.

**CASE II. Menstrual history.**—Patient is a colored woman of rather low intelligence and gives an indefinite history of her menstrual symptoms up to a few months ago, when the flow became profuse. Lately the hemorrhages have become excessive, reducing the patient to a very anæmic condition.

**Description of specimen.**—The uterus has been converted into an irregular tumor mass through which it has become so distorted that it no longer maintains any semblance to its normal form or size.

The main body of the uterus is very greatly enlarged and is studded over with subperitoneal tumors.

Upon the middle of the fundus a tumor the size of a foetal head is attached by a thick fleshy flat pedicle. The surface of the tumor is of a dull grayish-white color, and shimmering through the peritoneal covering are yellowish necrotic-looking areas. On the left lateral wall there is a nodule about the size of a hen egg, which has undergone calcareous change.

**Injection.**—Carmine red and granular blue gelatine injection mass.

The left uterine artery was taken as the initial injection point, from which the entire left side became faintly red and then gradually spread upward through the fleshy pedicle of the large tumor and partially injected the peripheral areas.

Very soon after the beginning of the injection the fluid gelatine began to flow from the opposite ovarian vessels.

While injecting the second uterine vessel the fluid began to flow from the cervical canal in a large stream, showing that there must be extensive oozing within the cavity.

The ovarian vessels were injected in turn, at the completion of which the main body of the uterus and the base of the subperitoneal nodules were of a deep red color, but approaching the outer poles of the tumors the injection became fainter and fainter, until in some of them, especially the large and the calcareous tumors, there appeared to be a complete occlusion or destruction of the vessels.

**Examination of specimen.**—On section of the uterus a large submucous myoma 5x4 cm. was found covered by a fine leash of extremely thin-walled vessels varying from the size of capillaries to furrowed sinuses as large as a goose quill.

Numerous ruptures had occurred in these vessels as evidenced by the many areas where large exudations of fluid had occurred over the surface and by the large coagulated mass which filled the uterine cavity like a cast.

The endometrium appeared normal or hypertrophied, except over the tumor, where complete erosion had occurred, leaving exposed the capsule of the tumor with greatly dilated and thin-walled vessels running over its surface. On section the interstitial nodules presented the same appearances and poor vascular supply as noted in the preceding case.

The submucous and subperitoneal tumors show a marked variation in their vascular systems, due to the mobilization of the tumors from the interior to the surface of the uterus. In every instance the wreath-like arrangement has been destroyed, and the blood supply is obtained through the vessels traversing the pedicle or base of the tumors.

The center of the large subperitoneal tumor has undergone almost complete necrosis and consists of a cavity filled with a soft yellowish-white pulpy detritus, while one of the other nodules above noted has become calcified.

The center of the large submucous tumor is also of a very soft yielding brain-like consistence.

*Epitome of observations.*—Injection of well-nigh entire tumor mass from one uterine artery; full vascularization around but very poor within interstitial tumors; great failure in blood supply of subperitoneal tumors as a result of which one has undergone necrosis, the other calcification; complete disappearance of endometrium over submucous tumor and contiguous areas of the uterine wall; exposure of large sinuses within the capsule of the submucous tumor, with rupture of these sinuses and other smaller vessels; beginning degeneration of submucous tumor through failure of internal blood supply.

*Remarks.*—This specimen presents an interesting phase in the life history of myoma uteri, for it undoubtedly represents a stage in which the hemorrhage has reached its height.

Had this case been allowed to take its own course without the intervention of surgical measures, the subsequent history would no doubt have been marked either by death from acute anæmia or from a terminal infection, or by a complete extrusion of the submucous tumor, with a final cessation of the hemorrhage, for in this specimen there was no other interstitial tumor impinging upon the uterine mucosa, on the contrary they were all in process of mobilization towards the peritoneal surface.

The large subperitoneal tumor was already in an advanced stage of necrosis, and it is possible to conceive that notwithstanding the number and size of the tumors, a gradual decrease in size by slow absorption with final cessation of all threatening symptoms might have occurred.

In the days when these tumors were never operated upon, instances are recorded of large tumors disappearing which were no doubt of this character. It is of course a *reductio ad absurdum* to assume that the stone-like tumor would ever have disappeared through any disintegrating process, but it is not contrary to the natural history of these and of cases of lithopedion for calcified masses to remain *in situ* throughout the natural life of their hostess without inducing serious consequences.

These remarks are simply incidental and bear purely upon the supposititious terminations of such cases as these, and they

are in no sense intended as suggestions for conservatism in their treatment. On the contrary, my views are radically in favor of nothing less than a total hysterectomy.

Even assuming that this post-operative knowledge might have been in the surgeon's possession at the time of operation, no other course than that pursued would have been advisable, for while the case might have terminated favorably under a conservative policy the dangers of a fatal hemorrhage, of a long drawn out illness from prolonged necrosis or from suppuration of the submucous tumor, of a rapidly lethal terminal infection, or of many other immediate or remote complications would have so far overshadowed this result as to make it extremely bad surgery to do less than perform a hysterectomy.

*CASE III. Menstrual history.*—Menses occurred first at 14 years, regular, accompanied by considerable pain; since onset of present disease the flow has been thinner and is more watery than usual.

*Description of specimen.*—Irregular multinodular myoma measuring 15 x 10 cm. in size. The uterus is so distended by the irregular growth and distribution of the tumors that it has lost all appearance of its original shape. The base of the uterus where it has been amputated is irregular and the uterine arteries stand out prominently as large patulous tubes. Two interstitial tumors have well-nigh reached the stage in their mobilization towards the peritoneal surface where they may be designated as purely subperitoneal. On palpation of the mass two or three large interstitial tumors may be outlined.

*Injection.*—Granular blue and red injection mass. The same phenomena were observed in the topographical distribution of color as in the foregoing experiments. On applying increased pressure to the injecting apparatus towards the close of the experiment the gelatine was seen flowing from the uterine cavity as a thin, delicate film.

*Examination of specimen.*—On section the uterine wall was found to be occupied by two large interstitial and three partially subperitoneal tumors. The uterine cavity was somewhat tortuous, distorted and considerably lengthened. The mucosa was of a uniform deep red, dotted over with numerous blue puncta, indicating the terminal points of the arterial branches. The thickness and consistency of the mucosa, so far as macroscopical appearances were concerned, were normal, and in only one area on the lateral wall of the fundus was there any encroachment of the interstitial tumors upon the cavity, and even here the small nodule, although projecting as a hillock into the fundus, had as yet induced no mechanical changes in the endometrium. The partially subperitoneal tumors are as yet well provided with a peripheral wreath of vessels, although the substance is of an alabaster-like whiteness.

*Epitome of observations.*—Usual circulatory phenomena resulting from the injection of one artery; tumors all interstitial, some moving toward the peritoneum while one small one tends to become submucous; mucosa intact, no mechanical changes.

*Remarks.*—In this case the patient entered the Hospital suffering from the effects of chronic salpingitis and peri-öophoritis, the lateral structures being intensely adherent and extensively diseased. The operation of total extirpation was therefore



indicated, not for the relief of the myomatous condition, but for the lateral disease. Given such a case as this, without any coincident disease of the appendages, the proper treatment should be absolutely conservative, for there is no immediate indication for operation. Should, however, the menses become too profuse or irregular a simple curettage would suffice to relieve the symptom, for we see that at this stage of growth there is but the one small tumor tending to become submucous, while the others push out towards the peritoneum. Such cases as these may go on to the formation of multinodular pedunculated submucous tumors, which sooner or later undergo softening and expulsion, after which all uncomfortable symptoms cease.

**CASE IV. Menstrual history.**—Flow began at 16 years, at first monthly, but during the last six years her periods have been two months apart. Flow continues one week, then ceases for 1½ days to return for 2 or 3 days. Flow is scant and accompanied by pain. Last period May 2d. Operation May 9th.

**Description of specimen.**—Globular myoma, measuring 15x10 cm., occupying the posterior wall of the uterus.

**Injection.**—Carmine gelatine. At the completion of the injection the red gelatine was escaping in a small filmy stream from the cervix.

**Examination of specimen.**—On section the tumor presented on first sight all of the appearances of the submucous variety, but on closer inspection was found to be entirely interstitial, for although projecting very greatly into the uterine cavity it was nevertheless surrounded entirely by the uterine musculature, which averaged 1 cm. in thickness. The mucosa was not perceptibly thinned out. The tumor itself, contrary to the usual rule, was extremely vascular, being penetrated by many large dilated vessels.

In the uterine tissue between the myoma and the mucosa there were many large vessels, which in the mobilization of the tumor had been pushed ahead of it. The tumor projected 6 cm. into the uterine cavity, having originated in the fundal portion and grown downward into the cavity, distending it quite equally on all sides. The endometrium was intact and showed no thinning at any point, except at the apex of the tumor, where it was slightly atrophic.

**Epitome of observations.**—Single large interstitial globular tumors which, so far as morphology was concerned, presented at first sight the appearance of a submucous tumor. Marked exception to the rule on account of extreme vascularity of tumor. Little or no atrophy of mucosa. No excessive bleeding, on the contrary decrease in the frequency of the menstrual periods.

**Remarks.**—This is one of the most interesting cases in my entire collection, because it illustrates so well the purely mechanical principles governing the deviation of the menses from the normal flow. Here, notwithstanding the excessive vascularity of the tumor and the uterine wall, the patient had suffered from absolutely no excess in her menstrual bleeding. The study of the specimen at once shows that the two essentials for hemorrhage, first, the erosion of the mucosa and second the retardation or stagnation of the blood currents through the mechanical conditions induced by the tumor, are absent, consequently no hemorrhage had occurred. The

second point to which I would draw attention are the possibilities in the line of operation. Although this tumor was quite large and had caused wide distention of the uterine wall and extensive distortion of the uterine cavity, a simple myomectomy could nevertheless have been performed, leaving to this woman, who was only 36 years of age, a uterus which might sooner or later have been sufficiently restored to its normal shape and condition as to be capable of bearing a child. A simple myomectomy is now invariably performed upon such cases in the gynecological clinic of the Johns Hopkins Hospital without even the thought of resorting to hysterectomy.

**CASE V. Menstrual history.**—Menses at 13; as a rule regular, painless, duration 5 to 7 days. Of late the flow has grown more profuse, but is still regular.

**Description of specimen.**—Large globular uterus 6x16 cm. in size with densely adherent and mutilated left ovary and tube. The consistency of the tumor is soft, doughy and plastic, and can be moulded into any shape.

The main development of the tumor is in the posterior wall of the uterus and partakes of the characteristics of both the submucous and subperitoneal types on account of its growth towards the peritoneal and uterine cavities.

**Injection.**—Carmine gelatine. Points of injection, the left uterine and right ovarian vessels. The first point injected was the uterine vessel from which the left lower segment was first colored red, then the left cornu and middle portion, following which the injection mass rapidly spread over the entire uterus, imparting a brilliant carmine red color to it.

To insure the fullest distention of the vessels, notwithstanding the apparent perfect injection of the entire circulatory system, fluid was forced into the right ovarian vessel. During the course of the injection the red gelatine, as in other preceding experiments, began to escape from the cervical canal.

**Examination of specimen.**—On opening the uterus the tumor was found to be a large interstitial one, undergoing necrosis. The peritoneal covering and capsule of the myoma showed a uniform intense red and blue injection, but at the point where it presented towards the uterine cavity was especially rich in vessels. The uterine cavity was considerably lengthened but not distorted. The endometrium was of a deep carmine color with numerous blue points appearing quite uniformly over its surface. The tumor itself was necrotic, its center consisting of a soft pulpy mass. The study of the injected fields in connection with the necrotic process is interesting, but offers no novel observation. As would be expected, the areas in which the circulation has been retarded, or has ceased altogether, are the ones undergoing necrosis.

The posterior portion of the tumor, next to the uterine cavity, is poorly vascularized, but near the apex two muscular whirls are still preserved which contain a few injected vessels. The central necrotic area shows no trace of blood-vessels.

The capsule of the tumor at its apex is one-half cm., in the anterior wall 2 cm., between the uterine cornu 1 cm., and opposite the uterine cavity 1 cm. in thickness.

The uterine mucosa is intact and at no point is attenuated. In this case the vessels of the capsule between the mucosa and uterine cavity were quite large and dilated.



*Epitome of observations.*—Large intramural myoma undergoing necrosis, vascular system within tumor almost completely destroyed, no involvement of uterine mucosa. Menstrual bleeding increased but no inter-menstrual flow.

*Remarks.*—In such a case as this the question naturally arises, What are the chances for final absorption of the tumor? With such a rich vascular supply around the tumor and its isolation from the uterine cavity the probabilities are that in time it would have entirely disappeared. The retrogressive changes, however, might have been slow, and the symptoms attending the absorptive process so unpleasant that we cannot consider this a case for conservative treatment, especially in view of the fact that the woman was 42 years old at the time of her admission to the Hospital. This case is a good illustration of that type so frequently referred to in medical literature in which the tumor disappears at or about the menopause. That this occurrence, however, is not of sufficient certainty to be depended upon will be shown in the reports of cases from the Johns Hopkins Hospital, for according to our observations the menopause is quite likely to be much slower in appearing, and even then the tumor instead of decreasing may grow larger.

I can hardly think it possible in such a case as this to achieve much success with a conservative operation; on the contrary, I should consider it bad surgery to attempt to save a useless organ in a woman 42 years of age, especially if this attempt were to be attended with more danger than a simple hysterectomy.

*CASE VI. Menstrual history.*—Flow began at 14 years; regular until 3 years ago; since then irregular, occurring some months twice and then possibly not for two months or more. Flow not excessive, lasting 4 days.

*Description of specimen.*—The specimen consists of a myomatous uterus and the right ovary and tube. The uterus is irregular in shape, being distended in its right latero-posterior walls by a globular intramural myoma 4x4 cm. in size. With this exception the general form of the uterus is preserved, measuring 7 cm. in length by 8 cm. in greatest width. Length of uterine cavity 5 cm.

Tube and ovary have been densely adherent, and are more or less mutilated by the operation.

*Injection.*—Carbimine and granular ultramarine blue gelatine. Only a very slight amount of the red fluid oozed from the uterine cavity during the injection.

*Examination of specimen.*—Section through the center of uterus shows the uterine cavity and the endometrium to be normal.

The myoma, which occupies one lateral wall, is strictly intramural and does not impinge upon the uterine mucosa. The tumor itself is sparsely vascularized, but has a very rich aggregation of vessels surrounding it.

*Remarks.*—In this case the indication for operation was the diseased condition of the ovaries and tubes, the myoma being merely a coincident complication.

In a case like this, unassociated with any pathological condition of the appendages, the line of treatment should be absolutely conservative, for a tumor of this nature gives no

discomfort until it has increased very markedly in size. With a simple growth like this, in which there is no impingement upon the mucosa, no derangement of function as a rule occurs. The slight change in the periodicity of the menses noted in the menstrual history can be accounted for much more readily by the diseased condition of the appendage than through any influence exerted by the myoma.

*CASE VII. Menstrual history.* Until a few months ago flow has been profuse, but not irregular; since then it has, at times, been almost constant.

*Description of specimen.*—Specimen consists of a uterus very greatly distorted by three myomata, one 7x7 cm. in size, occupying the fundus; the other two (5x5x4 cm. in size) the lateral walls of the uterus.

*Injection.*—Carbimine and granular blue gelatines. At the completion of the injection the red fluid was running from the uterus in quite a stream.

*Examination of specimen.*—Section through the nodule in the fundus shows it to be poorly vascularized while the surrounding uterine muscle presents a uniform red color with numerous blue points, indicating the position of the arteries. The tumor pushes down into the uterine cavity and is more than half submucous. The endometrium over the tumor has almost entirely disappeared, leaving the tumor towards its apex with a glazed whitish appearance and covered by thin-walled exposed vessels.

The mucosa is intact at the base of the tumor, but as it extends downward gradually becomes thinner and thinner until it reaches an equatorial zone or line of demarcation, where it is completely eroded and the vessels appear upon the surface. From the appearance of the vessels they are without doubt the original vessels which have surrounded the tumor in its intramural state, and with its mobilization towards the uterine cavity, have been pushed ahead of it. A small submucous tumor just below this one shows the same characteristics. A third submucous tumor springing from the lateral wall, through contact with the large tumor has been deeply indented. The mucosa of that portion of the uterine cavity not impinged upon by the submucous tumors appears considerably heaped up and thickened.

The two interstitial nodules show a moderately good injection, but not so intense as that of the surrounding uterine muscle.

*Epitome of observations.*—Large submucous tumor, the vessels of the capsule of which have become exposed by erosion and have given rise to profuse hemorrhage through rupture and diapedesis. Two interstitial tumors showing the typical wreath-like arrangement of their external vessels and a relatively poor internal vascularization.

*Remarks.*—This case shows best of all the mechanical basis for the excessive hemorrhage in advanced types of submucous myomata. Observations made in preceding cases taken in conjunction with the evident conclusions which may be drawn from the case in hand permits us with little doubt to outline the progress and the attendant symptoms of the submucous tumor distending the uterine cavity. At first it has originated as an interstitial tumor, with a rich peripical blood supply like those which still occupy an intramural position, but

through a disturbance of the surrounding equilibrium, excited by the contraction of the uterine muscle, it has begun to move towards the uterine cavity, that being, in this particular instance, the line of least resistance.

In its progress it has carried its surrounding wreath of vessels until the endometrium has been reached, and this, through the excessive tension produced by the tumor, has become attenuated and finally eroded until the capsule of the tumor, with its large thin-walled vessels, were exposed.

As resultant symptoms of the mobilization of this tumor, there was first an increased menstrual flow, due simply to congestion and stasis, but later through attenuation of the endometrium and exposure of its vessels; this became excessive and finally when the large sinus-like vessels became exposed, any slight exertion, such as undue exercise, coitus, etc., would give rise to profuse inter-menstrual hemorrhages simply through excessive diapedesis and actual rupture of the vessels.

While the mucosa in the areas covering the myomata was undergoing erosion that of the remaining portion of the cavity was being heaped up and increased in thickness, not only by a mere mechanical crowding and sliding upon its muscular base, but also through an actual hypertrophy or through congestion and oedema.

It is needless to say that any course of treatment in this case short of hysterectomy would be questionable, for the excessive involvement and great increase in the volume of the uterus with the marked distortion of the cavity would leave little hope of preserving the organ, even in the hands of the most skilled plastic surgeon.

**CASE VIII.\* Menstrual history.**—No derangement of flow.

**Description of specimen.**—The uterus is converted into a large irregular mass 21x18 cm. in size, consisting of one large subperitoneal tumor measuring 5x6 cm., several small ones of the same variety, and numerous palpable interstitial tumors.

The large subperitoneal tumor has become pedunculated, and although the blood supply, carried through the thick, fleshy pedicle would appear to be sufficient to maintain the nutrition of the myoma, it has secured an additional source, having established an adventitious or parasitic communication with the vessels of the left ovary, from the inner pole of which a large congeries of vessels cross over through a bridge of adhesions and spread out upon the apex of the tumor.

**Injection.**—Liquid Prussian blue with cinnabar granules held in suspension by agitation. The left ovarian artery was

\* On account of similarity to other cases in this report, Cases IX and X have been omitted.

first injected, the vessels of the broad ligament and the ovary first took the coloring matter, and then the fluid was seen to pass over the bridge of adhesions and penetrate the apex of the tumor. In the meantime the uterine branch of the ovarian artery had quickly carried the fluid to the uterus and almost simultaneously with the appearance in the tumor of the blue color from the adventitious vessels, it was also beginning to show itself in the pedicle and base of the tumor. About this time the cannula became blocked and the simple blue solution was then forced into the opposite ovarian artery, when the tumor and the remainder of the uterus assumed a deep blue color.

**Examination of specimen.**—On bisection of the tumor mass it was found that the large subperitoneal myoma, notwithstanding its adventitious and ordinary blood supplies, was undergoing necrosis, the center having already been converted into a pulpy mass. The other subperitoneal and two or more of the interstitial growths also showed a very poor vascularization.

The uterine cavity occupied a median position between the many tumors and, although distorted, at no point was there any invasion by the interstitial tumors.

The mucosa in general was thin but appeared perfectly normal with the exception of an area where a slight erosion had occurred.

At this spot evidences of a recent hemorrhage were seen.

**Epitome of observation.**—Subperitoneal myoma which, notwithstanding a second or adventitious blood supply had undergone necrosis. Little involvement of the endometrium. Tumors numerous, but all interstitial or subperitoneal.

**Remarks.**—This case represents the type of parasitic tumors which are by no means uncommon within the abdomen.

As a rule, the most common adventitious vascular source in such instances is the omentum. Frequently the nutrition of myomata, dermoid and simple ovarian cysts is greatly increased by the penetration of the growth with vessels from the omentum. Indeed it is not uncommon for tumors to maintain an existence even after a total severance from their original blood supply.

From our present operative standpoint in this case, only the radical operation could be advised, as it can readily be appreciated, that it admitted of no conservative treatment.

**NOTE.**—The reader's attention is called to a colored plate in Kelly's *Operative Gynecology*, Vol. II, p. 338, Plate XIX, drawn from a case in my series of injected specimens showing all the types of tumors. The relatively poor vascularization of the tumors stands in marked contrast to the deep carmine red of the uterine musculature. The main source of hemorrhage in the submucous variety is indicated by the vascular halo around the projecting tumor.

## A STUDY OF SIXTY-SEVEN CASES OF PRIMARY MALIGNANT TUMORS OF THE SUPRARENAL GLAND.

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Primary malignant tumors of the suprarenal gland are among the rarer forms of abdominal new-growths, and it is probably for this reason that so little attention has been paid to them in medical literature. Now, however, as sureness in

diagnosis increases and as abdominal surgery is becoming daily more simple and less dangerous, it seems time that a more prominent place should be given them in the roster of abdominal tumors.

I have endeavored, as far as possible, to collect all the published cases, and from them and the three which I have seen personally, to draw some conclusions as to the symptoms, the prognosis and the possibilities of operative treatment. No attempt has been made to discuss at any length the etiology of these growths, as it would involve too much space and be merely a reiteration of views already published.

Many difficulties have been encountered in this task, chiefly due to the incompleteness of the reports, and I have not attempted to change the classification of the tumors and have tabulated them under the name by which they were described by the author, though I was struck with the number of carcinomata observed by the older writers as compared with those seen at the present time.

The first two cases were admitted to the Gynecological Department of the Johns Hopkins Hospital, and were operated upon by Dr. Howard A. Kelly. The third case, which was operated upon in the Surgical Department, I owe to the courtesy of Dr. J. M. T. Finney.

*CASE I.—Globular Tumor in the Right Renal Region. Operation. Recovery.*

Mrs. C., white, age 53, was admitted to the Gynecological Ward of the Johns Hopkins Hospital, Dec. 26, 1896, complaining of a tumor in the right side of the abdomen. Her family history was good.

She has had the usual diseases of childhood, but otherwise has always been a healthy woman. Eight years before a cystic tumor of the right breast was removed. She had always menstruated irregularly, the menopause occurring at the age of 50. In January, 1895, or just one year before the patient was admitted to the Hospital, she first noticed a small, hard, oblong mass in the right side of the abdomen, which has slowly increased in size up to the present time accompanied by continuous stinging pain in the right lower abdomen, which has been much more severe during the past three weeks. The abdomen has never been distended, and she has never had any jaundice. She has lost 20 pounds in the last three weeks, is thin and anæmic in appearance, and there is a very slight brownish discoloration of the skin in places. The patient has never noticed any discoloration of the urine by blood, and on several careful urinary examinations after her admission to the Hospital no blood could be detected. The bowels have always been constipated.

On examination, the right side of the abdomen is found to be the seat of a large globular tumor, which occupies chiefly the right hypochondriac, the right side of the epigastric, and the upper portion of the umbilical regions, and the right flank below the ribs is bulged out by this tumor. On respiration the skin is seen to move over the tumor, but there is no respiratory movement of the tumor itself. On palpation a globular mass is felt, occupying the right side of the abdomen and reaching to the middle line. Above, the border is not distinct, but a deep furrow separates it from the costal margin. The most prominent portion anteriorly is occupied by a hard, rounded ridge extending inward and slightly downward, the ridge being about 12 cm. in length and 4 cm. in breadth, the ends appearing gradually to merge into the tumor. The surface except for this ridge and several smaller rounded prominences is smooth. It is slightly movable towards the left to firm pressure but gives the feeling of a fixed tumor. The measurement from above downward is  $6\frac{1}{2}$  inches, the greatest diameter being oblique, from the external border downward and inward—this measurement being 7 inches. The percussion note over the tumor is only slightly tympanitic in quality, save over the lower inner portion, where tympanitic resonance is found.

The clinical diagnosis of a renal new-growth was made from the position of the tumor, the history of constant increase in its size, and in spite of blood never having been found in the urine. It must be stated that a tumor of the suprarenal capsule or other retroperitoneal growth in this situation was never for a moment considered, notwithstanding the presence of the rounded ridge, so like in shape and size to a kidney.

*Operation.*—An incision was made in the median line 12 cm. in length. On opening the abdominal cavity the tumor was found generally adherent and crossed on the lower portion by the colon; the prominent ridge above spoken of was found to be the right kidney displaced and lying in front of the tumor. The peritoneum was carefully stripped off on both sides, the operator working down towards the vessels lying under the tumor. The ureter was first recognized and cut between two ligatures. The tumor was then somewhat raised, and first the large renal vein and then the artery were caught and tied, these maneuvers being difficult because of the proximity of vena cava. An enlarged gland near the upper portion was removed with the tumor. After the tumor was removed a counter-opening was made in the lumbar region and a gauze drain inserted.

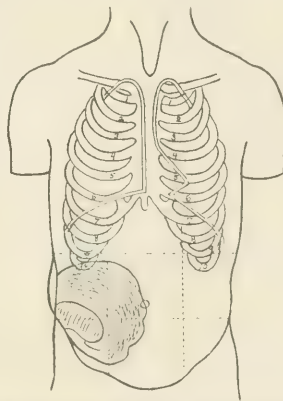


FIG. 1.—Shape and position of tumor. The rounded body indicated was the misplaced kidney.

The convalescence was retarded during the first three days by nausea and profuse vomiting, the vomitus being a brownish fluid. The pulse during the first few days was rapid and weak. The bowels were well moved on the fourth day, and after this the convalescence was uncomplicated.

The urine during the first day after operation measured 260+cc., the plus mark standing for an unknown amount which was lost; on the second day 625 cc., on the third day 275+cc., and on the fourth day 620 cc.

In a note made just before her discharge from the Hospital the slight brownish discoloration of the skin was noted as disappearing.

*Pathological Examination of the Specimen Removed.*—The specimen consists of the right kidney and a large retroperitoneal tumor. The tumor is irregularly globular in shape, measuring 11x11x13 cm., and presents a somewhat lobulated appearance, the larger nodules, which are three or four in number, averaging 3 or 4 cm. in diameter and projecting 1 or 2 cm. above the general surface of the tumor. One springing from the upper posterior portion is firm and resistant to the touch, the remaining nodules and the large tumor are distinctly fluctuant. The tumor is entirely enveloped in a vascular capsule with large and abundant vessels ramifying



through it, and where this is stripped off the tumor is of a yellowish color. Situated on the anterior surface of the tumor and attached to it by the lower four-fifths of its posterior surface by connective tissue is the slightly enlarged kidney, measuring 13x7x3.5 cm. The kidney for the most part has a deep red, mottled appearance, but presents a few bands or small areas of whitish fibrous tissue, and the upper portion of the anterior surface is occupied by an oval area 5.5x3 cm., which is of a yellowish-white color and slightly raised above the surrounding tissue.

Surrounding the tumor is a large amount of adipose tissue, and on the upper end of the kidney is a conical body 2.3 cm. long, firm to the touch and probably an enlarged lymph gland. Originating from the junction of the upper and middle thirds of the anterior margin of the kidney and crossing over the anterior convexity of the tumor is the flattened ureter resembling an empty vein.

After hardening in Müller's fluid and alcohol a cross-section through the kidney and tumor was made, dividing it into two equal halves, and it was then found that it was a thick-walled cyst, the walls measuring from 1 to 7 cm. in thickness, and the contents a thick yellowish colloid material. In several places in the wall, especially in the thicker portions which represented the bosses above spoken of, there were irregular cyst-like cavities containing the same colloid material. Sections made through various portions of the wall were studied microscopically and the following characteristics were seen. The cyst cavity had no definite limiting membrane, it being bounded by a layer of connective tissue poor in cell nuclei. Deeper in the tissue the character of the wall changed entirely. Here were found cells varying greatly in size and shape, some round, spindle, or irregularly shaped, and with round or oval rather lightly staining nuclei, with here and there a larger cell containing from 3 to 7 nuclei. These groups of cells were crossed in places by bands of lightly staining tissue. In other places again typical myxomatous tissue was found, and scattered through the wall were areas of connective tissue, which in places showed hyaline changes, and in others were thickly set with numerous small round cells, with round deeply staining nuclei. The tissue showed in places quite a number of blood-vessels, some being apparently formed of the tissue cells, while in other parts of the section the blood-supply is very poor, and this was specially noted where the hyaline changes were most marked. No suprarenal tissue was found in any of the sections.

The examination of the enlarged gland showed no metastasis, there being merely a hyperplasia of the tissue, which in places showed marked hyaline degeneration and commencing calcification. The kidney also showed no evidences of metastases; the whitish area above spoken of was due to a great increase in the interstitial connective tissue, with loss of the epithelium of the tubules and glomeruli, probably the result of interference with the blood-supply.

*Diagnosis.*—Fibro-myxo-sarcoma of the right suprarenal gland.

*CASE II.—Large Tumor in the Left Renal Region. Operative. Death.*

Mrs. C., white, aged 64, was admitted to the Johns Hopkins Hospital, February 11, 1897, complaining of a "lump" in the left side of the abdomen.

Her family history has always been good, and she has been a healthy woman, save for puerperal fever, which followed the birth of her child. The climacteric period appeared unusually early, menstruation ceasing entirely when she was but 30 years old. One year before her admission she began to feel badly, but complained of no definite illness. Two months ago she first noticed a tumor in the right side of the abdomen, about the size, at that time, of a goose egg, but which has since then grown rapidly, though without pain of any kind. She has lost flesh rapidly of late and feels weak and exhausted. The bowels have been obstinately constipated, and she complains of a sense of obstruction in the rectum. The urine never showed any signs of blood, and careful urinary exami-

nation, made after her entrance into the Hospital, showed a complete absence of blood from the urine.

The temperature taken twice daily for a week, between the time of entrance into the Hospital and the operation, was normal, only twice being found above 99°. There were no subnormal drops in the temperature. No brownish discoloration of the skin.

*Physical Examination.*—On inspection, a large rounded tumor can be seen filling the whole of the left side of the abdomen, with marked bulging of left flank below the ribs. There is no movement of the tumor with respiration. On palpation the tumor is found to be rounded, and no sharp edge can be felt. The surface is smooth, and the tumor has an elastic, almost fluctuant feel. It extends from just below the costal margin above, nearly to the level of the anterior superior spine below, and inward nearly to the median line. In its transverse diameter the tumor measures 20 cm. and measures 19 cm. from above downward. It is not tender on palpation, and is almost immovable, though with firm pressure it can be pushed slightly towards the median line. On percussion there is dull tympany over the lower inner portion, and here gurgling can be felt on palpation. The border of the liver can be palpated 2½ inches below the costal margin, and on pressure there is a sense of resistance and pain in the epigastric region.

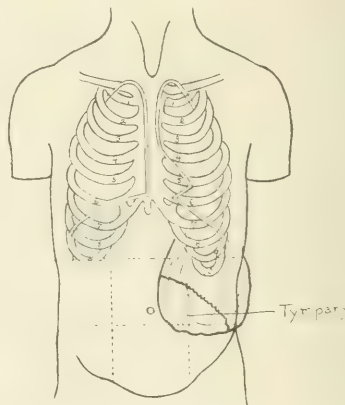


FIG. 2.—Shows position of tumor; the dark line is drawn to indicate where the tympanitic note ended.

The clinical diagnosis was "renal tumor" probably sarcoma from the rapid growth and elastic semifluctuant feel, though in this case, also, blood had never been found in the urine.

*Operation.*—The incision was made over the most prominent portion of the mass, beginning at the left linea semilunaris, on a level with the umbilicus, and extending around to the quadratus lumborum muscle, the incision measuring 25 cm. in length.

On opening the peritoneal cavity a large tumor was found occupying the left renal region, the surface being covered with extremely large veins. The kidney was displaced below and slightly behind the tumor, making it impossible to palpate it during the physical examination. The peritoneum was incised and pressed off the tumor by blunt dissection. Several large veins were cut and tied, but a great deal of blood was lost while attempting to free the tumor enough to reach the vessels below. By careful dissection, however, the tumor was partly raised from its bed, when on using a little more force than necessary the capsule ruptured, and masses of a soft tissue, looking like brain substance, poured out of the rent, accompanied by free hemorrhage. After this the attempt to remove the tumor completely was given up, the principal masses being taken

out piece-meal, one portion of the tumor being removed with the kidney. The vessels were tied, and after washing out much of the detritus with hot salt solution, a drain was introduced and the wound closed. On removing the patient from the operating table, no pulse could be felt at the wrist, and the face and extremities were cold and clammy. On her return to the ward, the foot of the bed was raised, stimulants were freely given hypodermically, and 1000 cc. of salt solution were infused under the breasts, while the arms and legs were bandaged. In spite of this however, she never recovered consciousness, and died one hour after leaving the operating room.

No autopsy was permitted, so we were unable to settle the question of metastases.

*Pathological Examination of the Tissues Removed.*—The specimen consists of a left kidney and a large tumor mass, weighing together 2340 grams. The tumor was mutilated during the operation, and consists of several large masses, to one of which the kidney was attached by its anterior surface. The tumor consists of a thin membranous sac, in many places less than 1 mm. in thickness. Springing from the inner surface of the sac and forming the contents of the tumor are masses of exceedingly friable tissue which, where the degeneration is not too far advanced, present a fine papillary or thread-like structure. On section of some of the larger masses they are found to consist of a fibrillated, apparently myxomatous tissue, enclosing irregular masses of a soft brain-like substance. The surface of the tumor is covered by dense adhesions.

The kidney measures 13x5.5x5; its surface is irregularly nodular, the fetal lobulations being well marked; the color is bluish or reddish. The lobules are in part firm and resistant, representing the fetal lobulations; in other places they consist of thin-walled cysts, varying from 3 mm. to 2.5 cm. in diameter. Emerging from the upper and lower angles of the hilum are two ureters, and several large arteries are present in the hilum.

Microscopically, the thin membranous sac is found to be composed of connective tissue, with a few elastic fibres scattered through it; from its inner surface there are numerous bands of connective tissue extending inward toward the center of the growth, and in the meshes thus formed are found cells, varying greatly in size and shape, some being oval, some round and some very irregular. The nuclei of these cells are usually round or oval, though in places they are very irregular and stain deeply. Sections cut from the centre of the growth show the same characteristic structure, there being thick bands of connective tissue extending in various directions through the growth, and from these thick bands smaller bands are given, dividing the groups of cells, which in some places are packed in closely, and in others almost every cell is separated by a fine connective tissue fibril from the others; again, in other places, though the meshes are quite good size, only a few irregularly shaped cells are found in it.

The blood-vessels follow chiefly the bands of connective tissue, though in places one can see among the cells blood enclosed either by one layer of flat cells, or in some cases apparently limited by the tumor tissue.

The kidney showed metastatic growth, following closely in type the primary tumor.

*Diagnosis.*—Large, round-celled alveolar sarcoma.

*CASE III.—Globular Tumor in the Left Renal Region. Operation. Death.*

Mr. M., white, æt. 53, was admitted to the Medical Ward of the Johns Hopkins Hospital, June 18, 1896, complaining of the presence of a tumor in the right side of the abdomen. The patient has had the usual diseases of childhood but otherwise considered himself a healthy man, and denied any venereal infection. In January, 1896, or six months before his admission to the Hospital he suffered with an attack of severe pain in the left side, which his physician thought due to impaction of feces and which was relieved by

simple purgation, but after the pain had disappeared a lump was discovered in the same side of the abdomen, which never disappeared. Since then the patient has never had an acute attack like the first but has complained at times of some soreness localized in the left side and never radiating. The bowels have always been regular. The stools have never contained blood or mucus, and he has never vomited, nor showed any signs of jaundice. During the six months he has lost 20 pounds in weight and becomes very easily exhausted on any exertion. The urine has always been light in color and normal in quantity. The clinical and microscopical examinations of the urine revealed nothing abnormal.

Examination shows the patient to be a healthy-looking man, though there is a fairly well marked cachexia. The heart and lungs are normal. In the left hypochondrium extending into the epigastrium there is a prominence which fills the costal groove. On palpation, corresponding to this area, there is a firm mass occupying the left half of the epigastrium. The mass does not extend much beyond the middle line. Below, it slopes gradually and passes deeply into the posterior portion of the abdominal cavity. The deepest point can be felt almost on a level with the umbilicus.

Along the costal margin it can be felt passing deeply and filling in the upper part of the space between the costal margin and the iliac crest. Fingers in the renal region behind push the mass forward, though it is difficult to outline at times by bimanual palpation, and there is some tenderness on palpation.

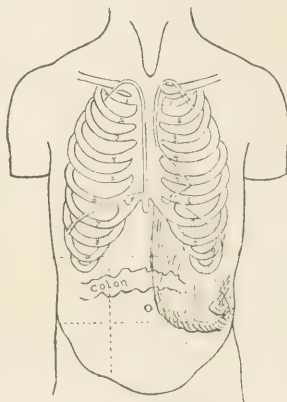


FIG. 3.—Shows position of tumor. Transverse colon, crossed inner portion.

The surface of the tumor is somewhat nodular in the flank and one nodular mass can be felt low down in the flank below the level of the umbilicus. Crossing the tumor transversely there is a large sausage-shaped mass, probably the colon.

After a week the patient was transferred to the Surgical Division and operated on by Dr. J. M. T. Finney, June 30, 1896.

*Operation.*—A transverse incision was made below the costal margin on the left side. The tumor was found to be quite adherent and was removed with difficulty, though there was no very marked hemorrhage, and the tumor was not broken up during the removal. It was doubtful for a time from which organ the tumor sprang, and it was at first considered to take origin from the left kidney. This was found intact and was left behind during the removal of the tumor. The spleen was pushed high up under the diaphragm, and on studying the relations of the tumor more closely, especially its relations to the kidney, it was found to be undoubtedly supra-

renal in character. As the patient was in a bad condition no further search was made, and the wound was closed.

Death occurred at 2.45 A. M., about twelve hours after the operation, from shock.

*Pathological Examination of the Specimen Removed.*—The tumor is an irregularly round mass about the size of a child's head, hard and firm in consistence over most of its area, but on the anterior surface there are several soft cystic elevations, each about the size of an English walnut. On opening one of these a soft brownish material characteristic of sarcoma exudes, and through the opening a probe could be passed well into the centre of the growth.

*Microscopical Examination.*—The capsule is of dense fibrous tissue, with distinct areas of round-cell infiltration in places. The cells lying immediately beneath the capsule are irregular in shape and vary greatly in size, some large and oval, with irregular nuclei, others round, and others again almost spindle-shaped. Numerous connective-tissue bands divide the cells up into groups, and in several places the individual cells are seen separated by fine connective-tissue fibres. This alveolar arrangement can be seen in many places, some of the alveoli being filled with the irregular cells, while in others the cells are principally distributed around the edges.

In another portion of the tumor many small blood-vessels are seen surrounded by denser masses of cells, which apparently take origin from the small blood-vessels and suggest in their arrangement a perithelioma. Giant cells are found in several portions of the tumor, usually with many centrally placed nuclei, and a protoplasm, granular, and staining deeply with eosin, and there is also a small area in another portion of the tumor which looks like normal suprarenal gland tissue.

*Diagnosis.*—Alveolar sarcoma of suprarenal gland.

The histogenesis of these tumors is still a matter of discussion, and many observations have appeared on the subject chiefly in connection with the new-growths in the kidney, taking origin from aberrant suprarenal tissue. Upon this point very little of added importance can be obtained from my specimens.

One interesting thing, however, was noted in the microscopical examination of sections from the tumor in Case III. In this many of the smaller blood-vessels were found surrounded by dense groups of cells, which apparently took origin from the endothelial cells of the vessel wall, and the tumor might therefore be classed as a perithelioma, though I have considered it as an alveolar sarcoma, for the principal picture was of a tumor of this type.

The ages of patients affected varied widely, and in the sixty-seven cases comprising both the carcinomata and sarcomata, the youngest was only 9 months old, while the oldest was 73 years.

Out of 37 cases of carcinoma, 22 occurred in the male and 15 in the female sex. Mankiewicz,<sup>61</sup> from the statistics which he gathered, considered carcinoma more common in the male sex, he having found 7 cases in the male to 4 in the female, and my statistics bear out this view, though from the limited number very little dependence can be placed on the figures. The average age in the 37 cases was 43.4 years, the youngest patient being 3 years old, the oldest 73 years old, and both the youngest and oldest being females.

Table I shows in which decades the carcinomata occur most frequently:

TABLE I.

Age not given	=2
1 year to 20 years	=5
20 " " 30 "	=3
30 " " 40 "	=7
40 " " 50 "	=5
50 " " 60 "	=8
60 " " 70 "	=6
70 " " 80 "	=1

The averages for the sarcomata were drawn from 30 cases, of which 14 occurred in the male and 11 in the female, the sex of five not being noted. In this group the preponderance of the male over the female sex is not so marked. The average age of the 30 cases was 31 years, the youngest being 6 months old, the oldest 64 years.

Table II shows the relative frequency of occurrence in the various decades of life:

TABLE II.

6 months to 10 years	=8
10 years " 20 "	=1
20 " " 30 "	=2
30 " " 40 "	=2
40 " " 50 "	=7 (?)
50 " " 60 "	=4
60 " " 70 "	=2

I am sure that the above figures are not of much value in making the diagnosis between carcinoma and sarcoma, as some of the tumors classified as carcinomata were undoubtedly sarcomata, and probably vice versa, but they show that the male sex is more frequently attacked than the female.

#### SYMPTOMS.

In first studying the symptoms connected with a suprarenal neoplasm, a resemblance to the classical description of Addison's disease is immediately seen. This resemblance was first noticed by Addison himself while studying the disease which has received his name, and in his monograph<sup>1</sup> he speaks of two cases of secondary carcinoma of the suprarenal gland in both of which many of the symptoms were similar to those occurring in tuberculosis of the gland, and though the skin did not show the typical bronzing there was a peculiar dirty brownish color present, which, since then, has been noted by other observers as occurring in the new-growths of the suprarenal gland. From these two cases Addison classified malignant neoplasms of the suprarenal as one of the causes of Addison's disease.

On considering, however, more carefully the symptoms complained of in the cases collected, and in comparing them with the definition given by Addison, the resemblance is not nearly so marked, and especially the skin changes and the disturbances of the circulatory system are absent in most of our cases.

I will not attempt the question as to whether in Addison's disease, and of course also in other disturbance or destruction of suprarenal capsule, the symptoms, more especially the skin changes, are due to changes in the suprarenal itself, or to



involvement of the sympathetic nervous system, but will merely quote several interesting cases, as tending to prove that some of the symptoms may be due to involvement of the sympathetic fibres, rather than to changes in the suprarenal gland. Fleiner<sup>11</sup> described a case of primary carcinoma of the stomach with metastases to various abdominal organs, among them the suprarenal glands. There was a distinct bronzing of the skin and of the mucous membrane of the mouth, and besides the carcinoma of the suprarenal there was a carcinomatous involvement of the abdominal sympathetic nerves. Leva<sup>12</sup> describes two cases of primary suprarenal new-growth without pigmentation, in which the abdominal sympathetic nerves were not involved, and explains the common absence of bronzing in this affection by the idea that the bronzing is due rather to involvement of the sympathetic nerves than to changes in the suprarenal gland, and he thinks tuberculosis is much more apt to involve the sympathetics, and therefore, more apt to cause the bronzing.

The case of Fleiner seems to bear out Leva's theory quite well, and it seems rather strange, to say the least, that if the pigmentation is due to destruction of the gland alone why we should not always see it in malignant growths.

In the attempt to classify the symptoms, carelessness in reporting cases gave much trouble; I found also a certain number of cases in which the symptoms given were evidently due to other diseases, which were either the actual cause of death, or which were so marked as to mask the suprarenal symptoms.

In the 67 cases collected there were only 37 which could be used in studying the symptoms. In these, the following symptoms were seen, cited in the order of frequency.

The most frequent symptom, seen in 22 patients, was a marked and steadily increasing loss of strength, accompanied in many cases by extreme languor and debility. Affleck and Leith<sup>13</sup> call especial attention to this languor in a case which they report, and say that "the difficulty of arriving at any diagnosis was enhanced by the natural apathy and indifference of the patient, due, no doubt, to the disease." Emaciation varying greatly in degree was noted in 20 cases; in some of these the loss of flesh was apparently not very marked, though in a few it was noted as extreme.

The intestinal system was the next attacked, in point of frequency: twelve patients out of 37 complained of nausea and vomiting. In nine there was loss of appetite; in four, diarrhoea; and in five, constipation. The circulatory system as compared to Addison's disease was rarely involved: four patients complained of palpitation of the heart, and in one the pulse was weak and thready. Six suffered with œdema of the legs, due in most of the cases at least to renal changes and not connected with the new-growth. Anæmia, varying from slight pallor to a high grade, was noted in seven cases.

Of interest is the fact that though there was extension of the growth into the vena cava and thrombosis, in four or five cases, these did not suffer with œdema. Affleck and Leith<sup>13</sup> call attention to this fact, and explain it by the collateral circulation which is established.

Complaint of pain located in various parts of the body was made in 25 cases. In some it was found in one or the other renal regions behind; again it occupied the whole back,

extending upwards into the shoulders, or downward into the thighs; others again complained of pain in the epigastrium or in one or the other hypochondriac regions; and in several there was marked tenderness on pressure either in the epigastrium or over the tumor. The pain was usually of an intermittent character when present, though occasionally it was continuous. In one case there was such severe pain in the knee and ankle joints that the medical attendant considered the patient to be suffering with rheumatism.

The skin changes were usually not marked; three out of the 37 showed distinct bronzing of the skin, and in nine there was some change in the color or texture of the skin, as for instance several patients were described as having a slight brownish discoloration; in others the skin was muddy looking, or of a yellowish color. In three patients there was marked jaundice due to coincident hepatic disease. In two there was a peculiar profuse growth of hair; both of these cases were in young female children, the one reported by Cayley<sup>14</sup> was a girl of three years, in whom the eyebrows were thick and bushy, and there was a line of dark hair on the upper lip. Fox's<sup>15</sup> case was a girl, also of about three years, spoken of as gross and bloated, with the whole body surface remarkably hairy, especially about the genitals and pubic regions.

Sleeplessness is noted by Hausmann<sup>16</sup> as occurring in a case reported by him, and he quotes Addison who has spoken of its occurrence in Addison's disease. I have not noted this symptom in any of the other cases; on the contrary, the tendency of the disease is to give rise to dulness and apathy.

The temperature is usually normal, there being but three cases in which any marked rise of temperature above the normal was noted, and in these three the rises of temperature were due to coincident lung disease. Berdach<sup>17</sup> is inclined to think malignant disease of the suprarenal is often accompanied by a lowering of the temperature, and he has reported a case illustrating this view, and to prove his theory has experimented with dogs by removing both suprarenals, with the result of lowering the temperature in every case. The reported cases, however, do not bear out his view, and I have found only one other in which any record of the lowered bodily temperature was made. The temperature in all three cases in my list was either normal or slightly above the normal occasionally.

Hæmaturia has been noted twice in the 67 cases, and this is important, as it makes the differential diagnosis between renal and suprarenal tumors more difficult. In one case reported by Troisier,<sup>18</sup> the hæmorrhage was due to a secondary cauliflower growth in the renal pelvis, and the hæmorrhage in the second case was due, evidently, to cystic changes in the kidney, as there had been a tumor present in the renal region for eight years, during which time the hæmorrhage had lasted, and at the autopsy, besides a primary sarcoma of the suprarenal gland, the palpable tumor previously felt was found to be a cystic kidney.

The presence of a tumor was noted a good many times, but in such a way that it was impossible in some of them to tell whether it was not first seen post mortem, and as a careful description of its appearance, position and relations was never given, it would be useless to merely cite the number of times in which a tumor had been noticed.

I wish next to call attention to a certain number of cases in which the new-growth caused no symptoms referable to the suprarenal. Out of the 67 cases, 13 can be grouped under this heading. There were five in which the symptoms were entirely confined to the respiratory tract; one died of pneumonia, another of gangrene of the lung, two from extensive metastatic growths in the lung, the symptoms being entirely referred here, and in the fifth case, the only symptoms were an intense bronchitis and weakness.

Of the remaining eight cases several were interesting; for instance Wallman<sup>22</sup> reports a case of a young dragoon corporal who, admitted to the Hospital for the treatment of an ulcer over the shoulder blade, was suddenly attacked by oedema of the glottis. At the autopsy scirrhus changes in the right suprarenal gland were found. Greenhow<sup>23</sup> had a patient, a young girl aged twelve, who, two months previous to her death had scarlet fever, and following this a general oedema, but no symptom referable to the suprarenal, though she had quite an extensive growth in this gland. Wigglesworth<sup>24</sup> also reports the case of an old woman dying of "general decay following cerebral atrophy," and at the autopsy marked carcinomatous changes were found in the suprarenal gland. The remainder of the eight cases gave about the same history.

#### DIAGNOSIS.

That the diagnosis is very difficult, and in some cases impossible, cannot be doubted, but I think with careful study of the cases which we may see, there are at least a certain number in which a diagnosis might be made. In considering the symptomatology, the most striking symptoms are the marked and steadily increasing loss of strength often accompanied by great languor and debility; the pain usually deeply seated in the abdominal cavity or radiating from one or the other renal regions; the marked emaciation and the various digestive and intestinal disturbances, added to which are in some cases the slight skin changes. If, in addition to these symptoms, there is a tumor present in one or the other renal regions we have a set of symptoms which, while not characteristic, are suggestive, and which would point to the possibility of a suprarenal origin. These symptoms are, unfortunately, not always present, and in the reported cases it is rare to find the whole set clearly marked, especially in combination with an abdominal tumor. The cases in which no abdominal tumor can be palpated are of course much more difficult to diagnose, and I doubt if in these a positive diagnosis can be made. Affleck and Leith<sup>25</sup> report a case of this kind, the patient having great and increasing weakness, gradual emaciation, loss of appetite, nausea and vomiting, and pain in the loins, passing thence around the abdomen and down into the thighs. There were no skin changes and no tumor palpable. This case was not diagnosed during life, though most of what we may call the cardinal symptoms were present.

The foregoing being the principal symptoms on which a diagnosis may be based, what are the other conditions which may simulate a suprarenal neoplasm?

The first of course to be studied are other changes occurring in the suprarenal gland itself. Of these the only ones which

can be mistaken for a malignant tumor are blood cysts and occasionally tuberculosis, the so-called adenomata being usually very small and giving rise to no symptoms.

Blood cysts of the suprarenal are rare. Drouboix<sup>26</sup> has collected a number, and I have been able to find several others. Their origin is not at all clear, but they are probably the result of a necrosis in the centre of a new-growth, usually an adenoma with a subsequent hæmorrhage into the necrotic area. The symptoms in some of the reported cases are exactly those of a malignant tumor, and I do not see here how a differential diagnosis would be possible. I will quote two of the most striking ones as of interest. Carrington's<sup>27</sup> case occurred in a Swede aged 54 years. He gave a history of gradually increasing languor and weakness, and gradually increasing epigastric pain, for two months preceding his entrance into the Hospital. On admission he was weak and languid, somewhat emaciated, his mind wandering at times. No nausea or vomiting was complained of. On examination a tumor was felt in the epigastric region, descending with respiration and tender on pressure. There was a darkening of the skin around the nipples and on the penis and scrotum, and this pigmentation became more marked before his death, which occurred three weeks later. At the autopsy both adrenals were found changed into cysts, globular in form and about the size of an orange. On section they were found filled with a light brown, grumous altered blood. The cyst walls on microscopical examination were found composed of normal suprarenal tissue. Floersheim and Ouvry<sup>28</sup> also report a blood cyst of the left suprarenal which simulated a new-growth. The patient was a woman aged 36, who began to suffer three years before with pain in the lower portion of the left chest, becoming worse after eating and causing attacks of dyspnoea and a feeling of constriction. Examination revealed a hard mass in the left hypochondriac region in the position of the left kidney. The urine was normal. She was operated upon, a median incision being made, and the tumor was found to be a retroperitoneal cyst. It was punctured and three litres of a brownish fluid were evacuated. The walls of the cyst were then attached to the walls of the incision and the wound was dressed. The patient died of peritonitis, and at the autopsy the cyst was found to be retroperitoneal, the kidney lying below and attached to it by the convex border. The walls of the cyst which were from 6 to 7 mm. in thickness, were found on microscopical examination to be composed of suprarenal tissue.

That tuberculosis of the suprarenal might simulate a new-growth is also easy to conceive, though it is rare to find a palpable tumor in these cases. A. F. Jonas<sup>29</sup> has just published a case which demonstrates this. The patient had a palpable tumor in the renal region with symptoms pointing to a suprarenal tumor. Dr. Jonas did an exploratory operation and was able to remove the suprarenal growth which proved on examination to be tubercular. The patient got well.

Tumors of the kidney are most often confused with suprarenal growths, and among the collected cases I found eight in which the diagnosis of renal neoplasm had been



made. This is not surprising when we consider that the suprarenal tumor is retroperitoneal, and occupies the same position as would an enlarged kidney. The differential diagnosis is based on the difference in the symptoms complained of in the two conditions, and on the presence of hæmaturia accompanying the renal neoplasm. This symptom, according to most observers, occurs in about 50 per cent. of renal neoplasms, and its presence might be considered conclusive, though as we have seen above, hæmaturia was present with two cases of suprarenal tumor, in one due to a secondary carcinoma in the renal pelvis, and in the other to advanced cystic disease of the kidney.

Rarely the kidney may be felt displaced by the suprarenal tumor, as occurred in Case I of our series, though even when felt it is difficult to recognize as the kidney. This possibility as an aid to diagnosis has also been noted by Pawlik in an article on renal surgery in one of the German journals.

Tumors of the liver have also been diagnosed where the trouble was really in the suprarenal, though in these cases the diagnosis has been entirely based on the presence of a large tumor in the hepatic region, and careful consideration of the symptoms and a painstaking physical examination would, in most cases at least, serve to distinguish the two.

Other conditions might also simulate a suprarenal tumor, as Berdach<sup>28</sup> in his article discusses the possibility of differentiating from retroperitoneal glands or a pancreatic cyst or neoplasm. Especially with a pancreatic cyst one could imagine the diagnosis to be difficult, as here also we get the emaciation, epigastric distress and nausea and vomiting, but the tumor is usually differently situated, and there are other symptoms which do not occur with the suprarenal disease.

Having considered the diagnosis it may be of interest to review our cases again briefly.

In Case I it seems now that the diagnosis should have been made, as she had many symptoms pointing to the suprarenal origin of the tumor. The presence of the kidney-shaped prominence on the surface of the tumor, the complete absence of blood from the urine throughout the whole illness, the slight brownish discoloration of the skin and the steady loss of flesh and strength were all of importance.

Case II would have been more difficult to diagnose correctly, as the symptoms were not so definite, and save for the complaint of feeling weak and badly and the rapid loss of flesh, there were no definite symptoms pointing to the suprarenal origin.

Case III was also diagnosed by the surgical staff without hesitation as a renal new-growth, and it was not until the incision was made that its true character was seen.

#### TREATMENT.

The treatment must necessarily be surgical, and unfortunately there have not been enough cases operated upon to be able to draw any very definite conclusions from them, so the indications and probable prognosis will have to be largely obtained from a study of the symptoms, duration, and post-mortem discoveries.

One learns first from a study of the symptoms that the disease is insidious in its onset, which tends to make an early

discovery of it rare, and when once developed the condition of the patient rapidly grows worse; and on this account any severe operation is more dangerous than it otherwise would be. That the course is a rapid one is shown in the fact that the average duration in 26 cases of carcinoma was, from the onset of the first symptom, 10.6 months, the least duration being 6 weeks and the longest 36 months. In sarcoma the average duration from the onset of the first symptom was even shorter, being but 6.7 months, the least duration one month and the greatest 13 months.

In examining the autopsy reports one finds there also several striking points which would evidently have an important bearing on the question of successful operation.

The first question which arises naturally when there are two organs of the same character in the body and one is to be removed, is what is the condition of the opposite organ? and when the retention of one is necessary to life this is a very vital question. This of course can only be answered in an incomplete way from the findings at autopsy, as necessarily in these cases the most ample time possible is given for the formation of metastases, but even with this the observer cannot but be struck with the great frequency with which both glands are involved, and also by the fact that in so many cases the glands on both sides are so nearly equal in size and general appearance, denoting either a simultaneous primary involvement or very early metastases. This is more especially marked in the carcinomata, there being in 30 cases where the side affected was noted 17 in which both glands were involved, the right side being alone affected in 6 and the left side in 7. Among the sarcomata this was not so marked; in 28 cases where the side was noted only 8 had both glands involved, the right alone being sarcomatous in 10 and the left in 10.

The frequency of metastases is also important, and the study of these from the post-mortem room is open to the same criticism, namely, that they had the longest possible time to develop, and that we should not be so likely to find them at an early operation. I attempted to get further light on this by studying the number of organs involved in the metastases and their apparent age, but found it impossible to get any reliable figures because of the incompleteness of the reports, but gathered enough to convince myself that the metastases in a good proportion of the cases occurred quite early, and were pretty widely diffused. In the carcinomata there were 28 cases where metastases were found in one or more organs, and in only three were they noted as not being present. The other six cases were so incompletely reported that their presence or absence could not be determined. In the sarcomata the metastases were not so frequent, being present in 14 cases, noted as not present in 6 cases and in 10 cases it was impossible to tell from the report whether present or not.

Among the carcinomata the organs most frequently affected were the lung in 15 cases, the kidney in 13 cases, the liver in 11 cases, the retroperitoneal glands in 7 cases, the stomach in 5 cases, the pleura and heart in 4 cases each, and almost every other organ in the body was noted as involved once or twice.

The sarcomata affected the liver in 6 cases, the kidney in 5



cases, the lung and the pleura each in 3 cases, and most of the other organs once or twice.

From these facts we may justly conclude, first, that an early operation is of vital importance, as, because of the insidious onset and rapid course, we will have to combat later, besides the difficulties of the operation itself, the lowered vitality and the lowered resistance of the patient. Second, that because of the probable early occurrence of metastases and the frequent involvement of both glands, the prognosis for final cure, even in the result of a successful operation, is unfavorable to say the least. Third, that because of the less frequent involvement of both glands, and the less frequent metastases, the prognosis in sarcomata is more favorable than in carcinomata.

The study of the difficulties occurring during the operation, and the results following it, naturally come next, and though we have but five from which to draw any conclusions, there are several interesting facts to be obtained from them. The cases are the three which I have reported, a case reported by Roberts,<sup>66</sup> of Philadelphia, with a fatal result, and two so-called suprarenal tumors removed by Knowsley Thornton,<sup>65</sup> with good results and briefly mentioned in his monograph "Surgery of the Kidneys." Only one of these can be used, as the other was undoubtedly a new-growth in an aberrant suprarenal gland in the kidney, for he speaks of the tumor as being surrounded by kidney tissue. Of these five, three resulted fatally: two immediately following the operation, and one in three weeks.

In Case I of our series the growth was firm and well outlined, and not adherent, and though some trouble was experienced in raising it from its bed and tying the vessels, the operation was not especially difficult, and except for the removal of the kidney with the tumor, gave no cause for anxiety, and as the result showed was perfectly successful. No troublesome hæmorrhage occurred during the removal. This case illustrates the most favorable growth that could be encountered. In our second case, however, a growth of a different character was found, illustrating well one of the difficulties which will be met, namely, a soft, friable tumor which when handled the least roughly breaks down and gives rise to almost uncontrollable hæmorrhage, besides making it impossible to remove it entirely. Dr. Roberts encountered the same difficulty in his case, and was compelled to abandon the operation because of the hæmorrhage before all of the growth had been removed, and his patient died three weeks later.

In Case III, while the tumor was removed entire, there was free hæmorrhage, and though the patient recovered from the anæsthesia, he died eight or nine hours later from shock, probably due to the long operation and his weakened condition.

In Dr. Thornton's case no account of the operation was given.

We find from these that the principal difficulties during the operation are free hæmorrhage and a tendency of the growth to break down during removal, and to these may be added the probability of dense adhesions, as in the pathological reports of many of the cases the tumor was noted as densely adherent to the surrounding organs, most often on the right side to the liver.

In spite, however, of the unfavorable outlook for a successful operation, it is best that at least an immediate exploratory operation should be advised in all cases where there is suspicion of a suprarenal new-growth being present, and this is even more true when a tumor is palpated, as we must remember that without operation the result will necessarily be rapidly fatal.

The question as to whether a further operation should be done in the event of finding a suprarenal tumor will depend on the character of the growth itself, the condition of the other gland, the absence of any visible metastases and the absence of dense adhesions. If the further operation is decided upon it is wise to remove the corresponding kidney, as we have seen that in 31 cases of carcinoma metastases were present 11 times.

The final result in our one successful case has been good so far, the patient being healthy and with no signs of any return of the growth.

#### SUMMARY.

To summarize we find the following facts true: 1, that while malignant tumors of the suprarenal gland are rare, they should be considered as one of the factors to be eliminated in the presence of an abdominal tumor; 2, that they are somewhat more common in the male sex; 3, that while in a certain proportion the symptoms are fairly well marked, there are many in which no symptom points to the suprarenal origin; 4, that rapid loss of strength, debility, emaciation, digestive disturbances and abdominal pain are the most prominent symptoms; 5, that skin changes are rather the exception than the rule; 6, that they run a rapid course, the duration being shorter than usual with a neoplasm in other organs; 7, that the diagnosis is impossible in many, and difficult in all, cases; 8, that a differential diagnosis must be made from other suprarenal diseases, from renal tumors, from hepatic tumors, from diseased retroperitoneal glands, and from cysts and new growths of the pancreas; 9, that the prognosis is always serious, even following a successful operation, from the great frequency with which both glands are found involved, and the tendency to early metastases; 10, that operation gives the only hope of relief, and that it has been successful in two cases; 11, that the principal difficulties in the operation are, the friability of the tumor, the great tendency to hæmorrhage, and the frequency of adhesions.

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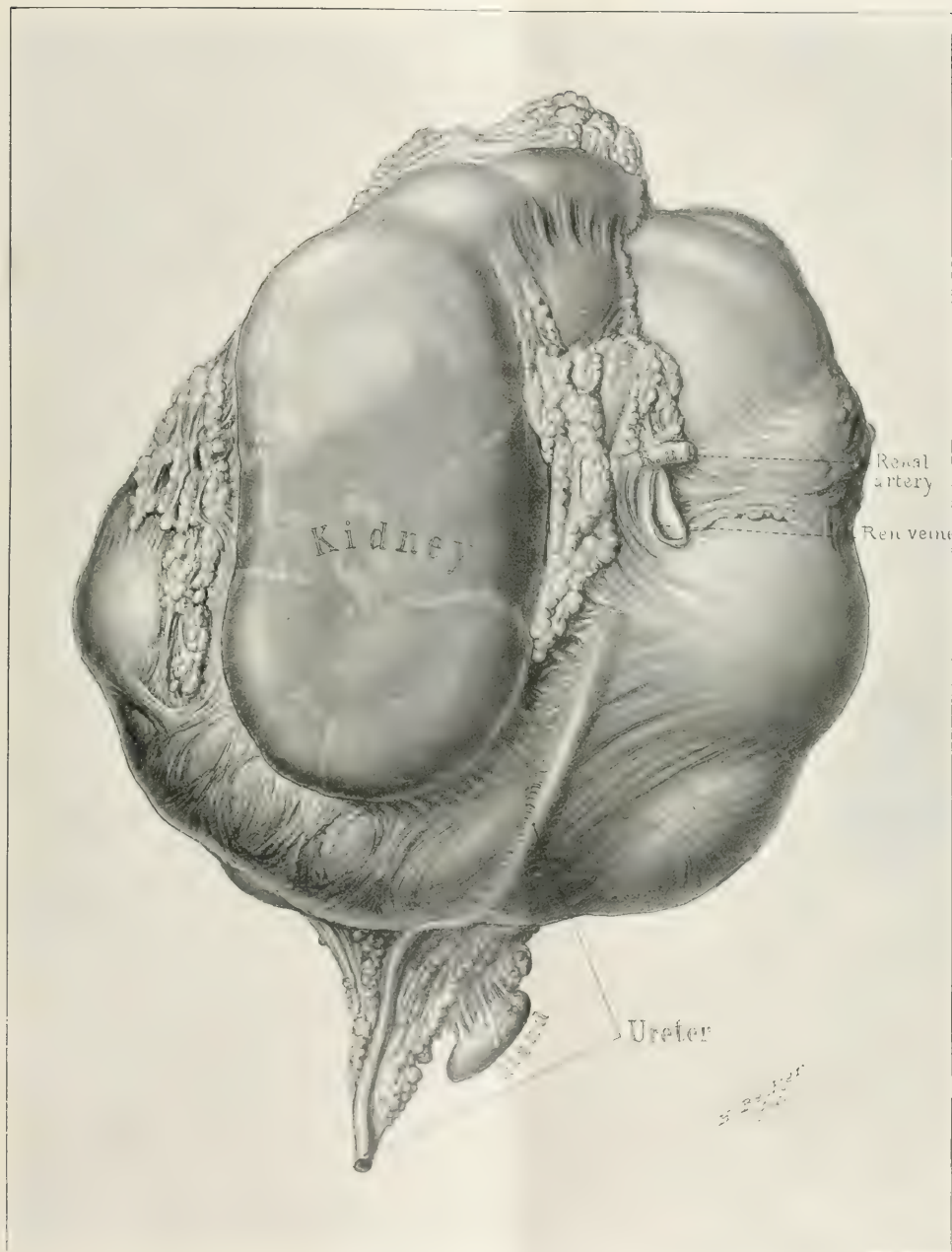


FIG. 1.—Tumor with kidney attached. Natural size. Case No. 1



FIG. 2. Same tumor cut in two. Shows the gelatinous contents of cystic cavity. The smaller size is due to the hardening process, as is also the dark color of the gelatinous material contained in the cyst.



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## THE BACTERIOLOGY OF THE CAVITY OF THE CORPUS UTERI OF THE NON-PREGNANT WOMAN. A REPORT OF 68 CASES.

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So much has recently been written concerning the bacteria of the female genital tract that unless one proposes to publish a book upon the subject, as has been done by Menge and Krönig, a complete and careful review of all the literature relating to it is impracticable. I will refer those who wish to have this, to the work of the above-named authors, "Bakteriologie des weiblichen Genitaltractus, Leipzig, 1897." I will here briefly review the work done by the more prominent investigators upon the bacteriology of the uterine cavity, and then add the data obtained by my own investigations. This work relates only to bacteriological examinations of the cavity of the corpus uteri, but in order to make some of my conclusions clear I will briefly give the status of the bacteriology of the vagina and cervix at the present time.

The vaginae of both pregnant and non-pregnant women can be regarded as being, under normal circumstances, free from pathogenic bacteria. The introitus vaginae is the outer boundary of this aseptic zone. The normal vagina contains its peculiar micro-organisms, but the pathogenic bacteria, when introduced into it, quickly disappear. The abnormal

cases in which the vagina may contain pathogenic bacteria are cases of gonorrhoea, acute wound infections extending into the vagina, where the secretions of infected uteri, etc., are being constantly poured into the vagina, those cases in which the vagina contains dead nutrient media as in carcinoma of the cervix uteri with hæmorrhage and necrosis, cases of retained placenta, of necrotic submucous myomata, uterine polypi, and in tuberculosis of the vagina. This, in general, is in accordance with the views of Döderlein, Menge, Krönig, Williams and others, and the weight of evidence is decidedly in its favor. Opposed to this view are Ahlfeld, Kaltenbach, Walthard, Vahle, Kollman and others, who think that the streptococcus and the staphylococcus pyogenes, the colon bacillus and other pathogenic bacteria are to be found in a large percentage of all vaginae.

The cervical canal is likewise, under usual circumstances, free from pathogenic bacteria, and from a point at or just above the external os contains no bacteria whatever. The gonococcus of Neisser and possibly the bacillus of tuberculosis alone have the faculty of invading and invading the normal

cervical canal, but under conditions mentioned in connection with the vagina, that is, a necrotic or putulous cervix coupled with dead nutrient material in its canal along with similar disturbances of the aseptic properties of the vagina, other bacteria, indeed the streptococcus and staphylococcus pyogenes, may invade the cervix without their introduction by means of external agencies.

The mucosa of the corpus uteri may either be free from or show inflammatory changes, and it is well in studying the bacteria of the cavity of the uterus to classify the cases according to whether the mucosa shows this endometritis or not. Most writers classify endometritis into *glandular* where the uterine glands show hypertrophic or hyperplastic changes without infiltration of the mucosa with small round cells or polymorphonuclear leucocytes, and into *interstitial* where this infiltration occurs. As most investigators agree that bacteria are not present in the glandular type of endometritis, and as in many cases this form of endometritis seems to be not dependent upon bacteria, I think it well to follow the classification made by Dr. T. S. Cullen, and will speak only of endometritis in the cases where this infiltration occurs. I will follow his subdivision further in classifying it into acute and chronic with the intermediate subacute stage. In acute endometritis there are changes in the epithelium, infiltration of the mucosa with small round cells and polymorphonuclear leucocytes and increase in the number of blood-vessels without increase in the connective-tissue elements. In chronic endometritis there is less change in the epithelium, an infiltration of the mucosa with small round cells, increase in connective tissue, thickening of the walls of the blood-vessels, and generally atrophic changes in the uterine glands. When the uterine cavity contains a considerable quantity of pent-up pus so that its wall may be likened to the sac of an abscess cavity the condition is known as pyometra. Physometra or tympania uteri is the condition in which the uterine cavity contains gas.

In the autumn of 1894, at the suggestion of Prof. H. A. Kelly, and of Dr. Jno. G. Clark, then resident gynecologist of the Johns Hopkins Hospital, I began the bacteriological examination of the body cavity of uteri removed by the method then in vogue in this clinic and in America generally, *i. e.* supravaginal amputation of the uterus. Circumstances prevented the examination of many of the cases operated upon, and absence from the Hospital and other causes prevented me from securing the number desired. However, I have examined the body cavity of sixty-eight uteri removed for a variety of causes, and I give in the table a summary of the results obtained. The relative numbers of cases of carcinoma, myoma, etc., examined do not represent the proportion of such cases operated upon in the Hospital. Very few of the carcinoma cases were examined bacteriologically, as the bacteriological examination destroyed, to a certain extent, the histological value of the specimen. The technique observed in making the bacteriological examination was as follows: As soon after the removal of the specimen as possible, and before it was handled, to burn thoroughly the amputated end of the organ, and then invade the cavity through the cervical canal with a platinum loop which had been heated to redness. As a rule,

cover-glass preparations of the secretions thus obtained were stained and examined microscopically, and cultures made upon various nutrient media. The cover-glasses were stained for bacteria by the usual methods. Gram's method of staining and the usual stain for the bacillus tuberculosis were used where indicated. The cultures were made upon agar slants or Petri dishes, stab cultures upon glucose agar and acid gelatin, and smears upon cyst-fluid agar or ascitic fluid agar or urine blood-serum agar, when these media could be obtained. I have also prepared a table containing a brief abstract of the histories of the cases, trying in these abstracts to embody everything relating to the nature of infection the operation, the convalescence, and the histological and bacteriological reports. As this table was too voluminous to be included in this article, the table given was prepared from it. This was deemed advisable, as Snger and other prominent writers have emphasized the fact that clinical signs are as much or more to be depended upon in diagnosing gonorrhoea in women than the microscopical examination of the secretions, and undoubtedly a combination of clinical signs and the bacteriological examination is the true method in making a diagnosis.

In glancing over the table, we see that of the 68 cases, 53 showed changes of an inflammatory nature as indicated either by endometritis, or by inflammatory changes in the uterine adnexa. The uterine mucosae in 51 of the cases were examined histologically, and 19 of these showed an acute, or subacute, and 12 a chronic endometritis. Eighteen of the cases showed no inflammatory changes in the endometrium. In none of the cases where there was no endometritis were bacteria found in either the stained specimens or in cultures. This, as we shall see later, corresponds entirely with the prevailing views upon the subject, *i. e.* that the body cavity of the normal uterus is free from bacteria. Concerning the bacteria found: the gonococcus was found seven times, the streptococcus pyogenes once, the staphylococcus pyogenes aureus once, the staphylococcus pyogenes albus twice, the bacillus of tuberculosis twice, and unidentified saprophytic bacteria four times. We have just stated that the gonococcus was found seven times, three times by cultures and cover-glass preparations, and four times in the stained specimens only. The micro-organism was found five times in the cavity of the corpus uteri, and twice in the pus from a pyosalpinx or ovarian abscess, and not in the uterine cavity. In all of these cases the typical biscuit-shaped diplococci were found in the pus in large numbers, lying both intra- and extra-cellularly, and decolorized by Gram's stain. The cultures were also characteristic. In another case the micro-organisms were probably found, but in such small numbers that Gram's stain was unsatisfactory. It was never found in the chronic cases of endometritis. In one case, where the gonococcus alone was found, there was an abscess in the uterine muscle, although the abscess cavity was not proven to contain the micro-organism. This cavity was not discovered until sections were cut for histological examination. One case showed a gonorrhoeal pyometra. The woman gave a history of an infection following a miscarriage. Upon dilating the cervical canal, about three drams of a thin, odorless, yellowish pus escaped.



This pus contained gonococci in large numbers. There was in this case a stenosis of the os uteri, probably either by a dilated cervical gland, or swelling of the mucosa as a result of the inflammation. Another woman, who gave a history of an infection immediately following a miscarriage, proved to be infected by the gonococcus alone. The micro-organisms were found at the operation in the secretions from Bartholin's glands, urethra, vagina, external os uteri, the cavity of the uterus, the acutely inflamed tubes, and in pus found in the peritoneal cavity among coils of intestines. The gonococcus was never found accompanied by other bacteria. It was found once in a myomatous uterus.

Of all the bacteria, the gonococcus is by far the most frequent invader of the uterine cavity. This micro-organism has the faculty of invading the uterus through the previously healthy cervical canal, causing an acute endometritis, and subsequently by direct extension along the mucous membrane of the genital tract inflammatory conditions of the Fallopian tubes, ovaries, and peritoneum. It probably always gains entrance to the uterine cavity through the cervix. In the uterus it generally limits its ravages to the endometrium, although it apparently penetrates in a small number of cases into the muscular structure of the uterus, causing a metritis and abscess formation. This is in accordance with the views of Wertheim, who found the microbe in the stroma of the uterine mucosa, and of Madlener, who found it in the uterine muscle. The case of mine would point to the same abscess formation in the uterine muscle. The acute purulent endometritis which it causes after a time becomes chronic or heals. From the uterine cavity it frequently extends along the mucosa, and is the cause of most cases of pyosalpinx, pelvic adhesions, pelvic encysted peritonitis, of circumscribed pelvic abscess, ovarian abscess, and probably of many cases of hydrosalpinx. It can, from the uterine cavity, get into the blood-current and thus cause a systemic gonorrhœal infection. It apparently lives but a short time in the abscesses which it causes, but can, probably, exist much longer in the mucous membrane of the uterus. It is noteworthy that in most cases of chronic gonorrhœal endometritis the micro-organism cannot be found by bacteriological examination. Sânger emphasized this fact and recently Broese and Schiller came to the same conclusion from the examination of 271 cases. Every one who has attempted to cultivate the gonococcus has noted the great difference in various cases with which the micro-organism grows. The fact that one cannot cultivate it, and does not find it in stained specimens, is not proof that it does not exist in a given case. Where the micro-organism occurs in very small numbers, Gram's stain, by which it is identified, is very unsatisfactory. Clinical signs point to its existence for long periods of time, and it may be given renewed vitality from time to time by a change in its nutrient media, as in the puerperium, operations on the uterine mucosa, etc. It appears to be more apt to invade the puerperal or menstruating uterus, and is more apt to be than is usually thought the cause of miscarriages. Interesting in this connection are the two cases previously mentioned, in both of which the women gave histories of an infection immediately following a miscarriage, and both of which proved to be infections by the gonococcus

alone. Neumann has recently reported a case where he examined a woman who had a gonorrhœal infection, and in whose decidua he found the gonococcus. Maslowsky also has recently reported a most interesting case, where a premature labor was caused by an "Endometritis deciduais interstitialis gonorrhœica." He found the gonococci in the decidua vera, which was infiltrated with small round cells. Fehling, Winkel, Krönig, and other authors believe this micro-organism to be a fruitful cause of miscarriage. It probably does not, by its presence, favor the entrance of other bacteria into the uterus, indeed, Menge and Wertheim believe that it will not tolerate other bacteria in the same field with it. In my seven cases it was not accompanied by other bacteria, nor in the cases which gave a gonorrhœal history were other micro-organisms found. It may be the cause of a pyometra. It is comparatively harmless to the peritoneum, for, although where it is being constantly poured into the peritoneal cavity, it always gives rise to a localized and perhaps, occasionally, to a general peritonitis, I do not find a well-authenticated case of death due to a gonorrhœal peritonitis. In one of the cases reported here, and in several occurring at various times in the clinic, where gonorrhœal pus was found free in the peritoneal cavity, after the removal of the pus and its source, the women recovered without any greater rise of temperature than one would expect in a clean case. In many of the cases of myomata, with inflammatory conditions of the appendages, this micro-organism is, probably, responsible for the inflammation. One of our cases, in which the gonococcus was found, was a case of myoma uteri.

The streptococcus pyogenes was found but once. This case was a negro woman with a large sloughing submucous uterine myoma. She entered the Hospital in an extremely weak condition—pulse 136, temperature 102°-104° F.—and died during the operation for removal of the myomatous uterus. The streptococcus, along with an unidentified bacillus, was found in the uterine cavity. There was undoubtedly a systemic infection by the streptococcus, although as no autopsy could be obtained this could not be proven. In this case the infection evidently occurred through the vagina, due to the following conditions: An open cervical canal due to the encroachment of the myoma, and to the uterus, cervix and vagina being filled with decomposing blood and necrotic myomatous material. Thus by overcoming the protective functions of the cervical canal and vagina, and by furnishing the bacteria with suitable nutrient media, this micro-organism which cannot under ordinary circumstances invade the uterus, found its way in and with a fatal result. This case corresponds entirely with the views of Menge and Krönig and with a case reported by Dr. Maurice H. Richardson in the *Boston Medical and Surgical Journal*, September, 1893, where a woman who had a facial erysipelas, and who was bleeding from a submucous myoma, died of a streptococcal peritonitis due to the invasion of the bacteria most probably through the genital tract. The streptococcus is of especial importance in puerperal infections but can, as we have seen above, cause infection in other conditions of the uterus, as in cases of myomata, carcinomata, necrotic polypi, and of course in operations upon the uterus, criminal abortions, etc. It is,



perhaps, in puerperal conditions nearly always introduced into the uterus by external agents, but can, as proven by Krönig's statistics, find its way into the puerperal uterus by growing in where no vaginal examinations have been made. In these cases it probably exists on the skin, clothing, etc., and finds in the vagina and cervix the suitable conditions for its extension. From the uterus it can gain entrance into the general organism through the lymphatics and the blood-vessels. In cases which do not run a rapidly fatal course, dense pelvic exudates in the connective tissue of the pelvis, filling the whole or part of the pelvis, and containing frequently small abscesses, are characteristic of a streptococic uterine infection. This micro-organism may enter the peritoneal cavity along the lumen of the Fallopian tubes, although the more common route of invasion seems to be by way of the lymphatics, thrombosed vessels and abscess formation in the uterine walls. It produces frequently a systemic infection. Pyosalpinx is not usually the result of a streptococcus infection. In the normal non-puerperal uterus the streptococcus probably cannot gain entrance into its cavity without the aid of external agents.

The bacillus of tuberculosis was found by histological examination to be the cause of the endometritis in two of the 31 cases, nearly 6.5 per cent. In these two cases no tuberculous processes were found in the Fallopian tubes, and in another case the hysterectomy was performed for tuberculosis of the tubes, when the endometrium of the uterus was free from disease. These two cases would seem to show that primary tuberculosis of the endometrium may occur, the bacteria gaining entrance through the vagina and cervix. Most writers believe this to be the case. Most cases of tuberculosis of the endometrium are, however, secondary to processes in the tubes, and this as secondary to tuberculosis in other parts of the body. Tuberculosis of the endometrium seems to stop suddenly at the internal os, and pyometra frequently results as a product of tubercular endometritis.

The staphylococcus pyogenes aureus was found once, and the staphylococcus pyogenes albus twice, in the uterine cavity. The former was found in a pyometra along with an unidentified bacillus in a case of carcinoma of the cervix. The woman gave no evidence of a general infection by this micro-organism. The staphylococcus albus was found once following the removal of a submucous myoma where, after five or six days, the woman's temperature rising to 104° quite suddenly, a bacteriological examination was made by means of Döderlein's tube, and the staphylococcus was found both in cultures and on slides, together with an unidentified bacillus. In the second case the micro-organism was evidently carried in by instruments. Here the woman was curetted before removing the uterus. The micro-organism was found by means of cultures in small numbers in the uterine cavity, while the pus from the pyosalpinx was sterile. The staphylococcus pyogenes like the streptococcus can invade the cavity of the uterus probably only when the protective properties of the vagina and cervix are overcome, as in cases of carcinomata, myomata, etc., or when carried in by operative procedures. Once in the cavity of the uterus, if the endometrium is unwounded and

under normal conditions, it soon disappears; but if the mucosa is wounded, or there is dead nutrient material there, it causes suppurative processes. It probably causes miscarriages by producing a deciduitis, as in a case reported by Neumann, or it may cause a general systemic infection, as in Strücnkman's case. It is more rarely found in the uterine cavity than the gonococcus and streptococcus, and probably than the bacillus of tuberculosis.

The other bacteria found were unidentified and were, probably, saprophytes. One was found in the streptococcus case, two in cases of pyometra, once in combination with the staphylococcus pyogenes aureus, and one in the case of submucous myoma along with the staphylococcus pyogenes albus.

In looking at our cases from a clinical standpoint we find a result that may not be uninteresting. Making a diagnosis as to the mode of infection from the history of the case, coupled with the bacteriological examination, we find that of the 53 cases showing inflammatory changes, 26 were, probably, of gonorrhoeal origin, 12 of puerperal origin, 3 due to tuberculosis, 4 to myomata or carcinomata, 4 to previous operations, and 2 unclassified. Some of the cases giving a history of puerperal infection undoubtedly owed their origin to the gonococcus. In our cases, therefore, the gonococcus was the probable cause of infection in more than one-half of them.

A few interesting points may be gained from the table. In two cases there was a hydrosalpinx and pyosalpinx combined in the same patient. Most writers think that pyosalpinx is due to bacteria, and many contend that bacteria have nothing to do with hydrosalpinx, and that hydrosalpinx is never the result of a purulent salpingitis. Our two cases would point to one and the same cause for both conditions. We see further that in four cases of hydrosalpinx, three of pyosalpinx, and two of ovarian abscess, there was, on histological examination, a normal uterine mucosa, i. e. no infiltration with small round cells, or polymorphonuclear leucocytes. There are only two explanations for this: one, that the infection did not occur via the uterine cavity, and the other that the pre-existing endometritis had healed. The latter is, in most cases, the most plausible explanation. We see cases of healed salpingitis also, hence it is more than probable that hydrosalpinx is frequently the end product of a suppurative salpingitis. Three deaths occurred, and it is instructive to investigate the causes: one, the streptococcus case was in a desperate condition when operated upon, and died on the table. The second died as the result of an intestinal perforation and the following peritonitis. The sigmoid flexure of the colon was injured during the operation and was sutured. This suturing gave way, and with a fatal result. The third was the result of an infection with the staphylococcus pyogenes albus, and streptococcus pyogenes secondary to drainage in a case, probably, originally gonorrhoeal. The cultures and stained preparations at the time of operation showed no bacteria. Drainage was through the vagina, and also through the abdominal wound. The staphylococcus infection occurred through the vagina, as proven by bacteriological examination before death. Both micro-organisms were found in the peritoneal cavity at autopsy. Death then in one of the two fatal cases possible to have been avoided was due to drainage. In the other case drainage

would possibly have saved the life of the patient, but was not indicated at the time, as the bowel was supposedly well sutured.

Let us see how our results correspond with the results obtained by the various investigators. Winter was among the first to examine bacteriologically the cavity of the uterus. As a result of his investigations he came to the conclusion that "the healthy body cavity of the uterus contains no bacteria." His work was done upon uteri which had been removed for myomata, or upon those removed by panhysterectomy. He did not examine the mucosæ of these uteri histologically. Brandt, in cases of symptomatic endometritis, found in 30 per cent. of all his cases pyogenic bacteria, and in the 25 cases examined only 3 were free from bacteria. Péraire, who also worked with cases of endometritis, found practically the same thing. Pfannenstiel, in both interstitial and glandular chronic endometritis, found no bacteria. Bumm states that in the chronic glandular and interstitial endometritis of non-pregnant women bacteria are in most cases not present, but that in a small number of cases one finds bacteria, which he regards as only an *accidental* accompaniment of these conditions, and which can change according to the character of the secretion. Wertheim says that the gonorrhœal infection of the uterus causes always a purulent catarrh which, when it becomes chronic, can produce a hypertrophy and hyperplasia of the uterine glands, and that the inflammation may extend to the myometrium. Gottschalk and Immerswahr found in cases of endometritis that bacteria were present in 65 per cent. of the uteri, and found frequently the staphylococcus pyogenes. They thought that the presence of the gonococcus predisposes to the subsequent invasion of the staphylococcus. Madlener went further than Wertheim, who had found the gonococcus in the stroma of the uterine mucosa, and found this micro-organism in the uterine muscle. He says that the gonococcus of Neisser has the faculty of penetrating the musculature of the uterus from the endometrium, and thus cause inflammation. Bumm, however, states that he examined Madlener's preparations and was not convinced that gonococci were present. Boije found bacteria present in 19 of 30 cases, and came to the conclusion that bacteria are the causes of interstitial endometritis, but not of glandular. Menge examined the body cavity of 119 uteri which had been removed for a variety of causes. Thirty-nine of these cases showed round-cell infiltration of the uterine mucosa, and 11 of the 39 cases were in carcinoma of the cervix. As a result of his investigations he comes to the conclusion that neither in the secretions nor in the tissue of the mucosa of the cavity of the corpus uteri, in cases showing no endometritis or only the glandular form, do bacteria exist which we can cultivate. In his 119 cases he found bacteria only 11 times. One case was that of a submucous necrotic myoma; two were cases of gonorrhœa; two, of tuberculosis of the endometrium; one, an unknown bacillus in an acute case; and the remaining five were in cases of pyometra. Opitz examined 10 cases and found all free from bacteria. Kollman reports a case of a myomatous uterus, in which the mucosa showed no inflammatory changes where he found bacteria present in the cavity. These were not identified. Warbasse,

in 17 cases of chronic endometritis, found bacteria present in 5 of them. He concluded, however, that the micro-organisms were not the cause of the endometritis, and that it is no more necessary to look for a bacterial origin of chronic endometritis than in inflammation of other glandular organs.

In looking over the literature of the subject we find that the following bacteria have been found in the uterine cavity in its various inflammatory conditions, *viz.* gonococcus of Neisser, streptococcus pyogenes, staphylococcus pyogenes aureus, albus and epidermidis albus, bacillus of tuberculosis, bacillus coli communis, bacillus ærogenes capsulatus, bacillus of tetanus, bacillus typhosus, diplococcus lanceolatus, and many saprophytic and unidentified bacteria. All of these bacteria have been found in the puerperal uterus. In the non-pregnant and non-puerperal uterus the only micro-organisms reported to have been found are the gonococcus, the streptococcus pyogenes, the staphylococcus pyogenes, the tubercle bacillus and saprophytic bacteria. The cavity of the corpus uteri of both the pregnant and non-pregnant woman under normal conditions is free from bacteria. The boundary line between this bacteria-containing and bacteria-free zone is the external os uteri. The only bacteria which can invade the cavity of the uterus through the external os without the help of external agencies, and under normal conditions are the gonococcus of Neisser and the bacillus of tuberculosis. Nearly all of the best-known investigators are agreed upon this view. Upon the causes of inflammation of the mucosa of the uterus and the bacteria which may be found there in cases of endometritis there is not such a unanimity of opinion. It is of vital importance to the surgeon to know if the streptococcus pyogenes, the staphylococcus pyogenes or other pathogenic bacteria do exist in the uterine cavity, and if so, under what conditions he may expect to find them, and what may be done to guard against carrying these micro-organisms into the peritoneal cavity or exposed wound surfaces. In the class of cases previously mentioned, where the protective functions of the vagina and cervix are totally, or in a measure, lost by means of a prolapsus, or very much relaxed vaginal outlet, an open cervical canal, or destruction of the cervix by carcinoma, where the cervix and vagina are filled with dead nutrient material as necrotic placental remains, carcinomata, sloughing myomata or polypi, both the pathogenic and saprophytic bacteria are liable to be encountered. Following also, of course, recent operative procedures upon the vagina or uterus, an acute wound infection may exist and thus infect the peritoneum of the patient upon whom a laparotomy is subsequently done. In puerperal sepsis, of course, also this danger exists. The gonococcus will also be frequently encountered in inflammatory cases, but may be disregarded so far as operative procedures are concerned.

In uncomplicated cases of hystero-myomectomy, hysterectomy for inflammatory cases, or ovarian tumors, operations for extra-uterine pregnancies, and in all such cases where the vagina and cervix are normal, except, probably, for the invasion of the gonococcus, the *safest route so far as infection is concerned is the abdominal*.

In operations for carcinomata, especially where the cervix is necrosed, in submucous myomata, especially if the tumor

encroaches on the cervix, and in similar cases of polypi, etc., in puerperal cases upon whom a hysterectomy is performed, and in circumscribed pelvic abscesses which are liable to be secondarily infected from the intestine, *the safest route with regard to infection is the vaginal.*

As the external genitalia and the surrounding parts are even more liable to contain pathogenic bacteria than the abdominal wall, the cleansing and disinfection of these parts is as imperative as the cleansing of the abdomen preparatory to operation.

Drainage through the vaginal vault in cases of laparotomy unless imperative to arrest hæmorrhage, or in cases of wounded intestine where the suturing is unsatisfactory, is almost as much to be deprecated as drainage through the abdominal wall. The vaginal vault should be, when possible, left intact.

In conclusion, I wish to thank Drs. Kelly, Russell, Clark and Ramsay for their aid and encouragement in my work, and Drs. Cullen and Hurdon for the pathological reports of the cases.

Total number of cases examined bacteriologically .....	68
No. of cases of an inflammatory nature .....	53
No. of cases of uterine myomata .....	24
No. of cases of carcinoma of cervix uteri .....	3
No. of cases of probable puerperal infection as shown by the history .....	12
No. of cases of <i>probable</i> gonorrheal infection as shown by the history .....	19
No. of cases of <i>positive</i> gonorrheal infection .....	7
No. of cases where endometrium examined histologically .....	51
No. of cases of endometritis with small round-cell infiltration only .....	12
No. of cases of endometritis with small round-cell and polymorphonuclear cell infiltration .....	19
No. of cases where there were no endometritis .....	18
No. of cases of pyometra due to { gonococcus .....	1
{ staphylococcus and saprophytes .....	1
{ saprophytes only .....	2
No. of cases of abscess in uterine wall (muscle) .....	3
No. of cases of tubercular endometritis .....	2
No. of cases where the streptococcus was found .....	1
No. of cases where the staphylococcus was found { albus .....	2
{ aureus .....	1
No. of cases where unknown bacteria were found .....	4
No. of cases of myoma uteri accompanied by endometritis or inflamed adnexa .....	9
No. of cases of myoma uteri where the endometrium showed no inflammatory change .....	11
No. of cases of pyosalpinx .....	24
No. of cases of hydrosalpinx .....	9
No. of cases of pelvic adhesions only .....	9
No. of cases of circumscribed pelvic abscess .....	3
No. of cases of ovarian abscess .....	5
No. of cases of hæmatosalpinx .....	2
No. of cases of hydrosalpinx of one tube and pyosalpinx of the other .....	2
No. of cases of hydrosalpinx with no endometritis .....	4
No. of cases of pyosalpinx with no endometritis .....	3
No. of cases of ovarian abscess with no endometritis .....	2
No. of cases of infection through the cervical canal due to myomata .....	2
No. of cases of infection through the cervical canal due to carcinoma of cervix uteri .....	2

No. of cases of infection through the cervical canal due to operation .....	1
No. of cases in which inflammatory changes in the uterine adnexa were due to previous operation .....	3
No. of cases of <i>probable</i> gonorrheal infection where endometritis was found .....	12
No. of cases of <i>probable</i> puerperal infection where endometritis was found .....	6
No. of deaths due to { drainage .....	1
{ intestinal perforation .....	1
{ streptococci infection .....	1

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## THE PRESENCE OF FOREIGN BODIES IN THE VERMIFORM APPENDIX, WITH ESPECIAL REFERENCE TO POINTED BODIES.

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The suggestion of a pin being the cause of an appendicular abscess as brought out in the history of a patient in the Gynecological Wards of the Johns Hopkins Hospital has led, with Dr. Kelly's encouragement, to this inquiry, as to foreign bodies in general as a cause of appendicitis, and especially pointed bodies.

The patient, a girl aged twenty, was admitted to the service of Dr. Kelly with a sinus in the abdominal wall at the right iliac fossa. It was stated that, when about six or seven years of age, she had pain in the right iliac region followed by an abscess developing sufficiently to be opened in forty-eight hours. The wound was dressed every day thereafter, and some time later a pin was found in the discharge from the wound and the whole trouble was attributed to that. There was no further trouble until about four years ago, since when she has had repeated attacks of appendicitis more or less typical.

As to the frequency with which foreign bodies other than faecal masses are found in the vermiform appendix, our opinions have changed greatly in the last ten years; at one time the presence of a foreign body was thought essential to an appendicitis, and the classical orange, date, or cherry seed were often described. Undoubtedly many of them, so eagerly sought, were nothing more than faecal concretions which are likely to assume these shapes, and unless carefully examined easily deceive the observer. From this extreme the other has now been reached. Many writers at the present day go so far as to state that foreign bodies are never found as the cause

of appendicitis, and this attitude would seem to find some justification in the following facts.

Fitz,\* in 1886, collected 152 cases of perforative appendicitis, and found 12 per cent. of foreign bodies with 47 per cent. of faecal concretions while Hawkins,† in 1895, in 67 fatal cases did not find a single foreign body. In 250 cases of appendicitis in the Johns Hopkins Hospital in the past ten years, there has been only one foreign body—a segment of tapeworm.

With this object in view I have collected 1400 cases from various sources in the last ten years, and find about 7 per cent. of true foreign bodies; while in 700 of these cases, in which a definite statement was made as to the nature of the foreign body, there were 45 per cent. of faecal concretions. The older statistics invariably give a higher percentage of foreign bodies.

While so many accounts are evidently untrustworthy because of lack of careful examination, the undoubted occurrence of many queer and interesting objects as shot, pins, worms, gallstones, a tooth, or a piece of bone, has been recorded; and even the discarded grape seed or cherry stone is occasionally seen. Fenger‡ had a case in which two grape seeds and an oat husk were found, and Welch once met with a date seed. Osler,§ in ten years' experience in Montreal, found foreign bodies only

\* Fitz: Transactions of the Association of American Physicians, 1886, I, 110.

† Hawkins: On Diseases of the Vermiform Appendix, London, 1895.

‡ Fenger: American Journal of Obstetrics, 1893, XXVIII, 168.

§ Osler: Principles and Practice of Medicine, 1898, 520.

twice: in one instance five apple pips, and in another eight snipe shot. Stone,\* of Omaha, and Ransohoff,\* of Cincinnati, each removed an appendix containing a bullet (Fig. 6) as the exciting cause. A case is reported by Holmes,† in which 122 robin shot were present in the appendix of an old man dead of pneumothorax, who, during life, had had no symptoms referable to the appendix; but who, it is stated, was very fond of game. Interesting in connection with this is the following observation in the *Mémoires de l'Académie Royale de Chirurgie* in 1743. "One notices sometimes in opening the bodies of persons who, during life, have eaten a great deal of game that there is collected in the intestines, and especially in the cæcal appendix, a great quantity of shot, without those persons having had the least inconvenience."

Gall-stones are not infrequent and cases are cited by Gibbons,§ Nelson|| and Ulloa y Giralt.¶ Fæcal concretions may so closely resemble gall-stones that it is impossible to distinguish between them except by chemical analysis. For the sake of exactness too much stress cannot be laid on this. A specimen kindly loaned by Dr. Rogers, of Memphis (Fig. 4), well illustrates this. The patient, a man aged twenty-two, had an attack of hepatic colic, with intense pain over region of gall-bladder, jaundice, vomiting, fever, etc. His trouble subsided and then after a few days symptoms of appendicitis appeared, which likewise subsided, leaving slight tenderness in the right iliac fossa. On examination three small nodules could be felt at the site of the appendix. Operation revealed an appendix distended with three bodies looking exactly like gall-stones, and such Dr. Rogers very rightly supposed them to be. Chemical examination by Dr. Thomas R. Brown, however, showed that they contained no cholesterin and no bile pigments nor salts, but were made up mostly of organic matter with carbonates and phosphates of calcium and magnesium.

One class of foreign bodies, however, far more common and more important than any of these, may be grouped together as pointed bodies. The only explanation that can be offered for their presence is in their shape, which allows them to become engaged in the cæcal opening of the appendix more readily.

A not uncommon occupant of the appendix is a lumbricoid worm. Numerous cases are recorded. One of the earliest of these is that of Blackadder\*\* in 1824. A man in apparent good health was seized with sudden abdominal pain, so intense that he fell to the ground and died in less than four hours. At autopsy nothing was found except that into the appendix which was remarkably increased in length and thickness and

felt like a firm cord, a large lumbricus had forced its way until only an inch of its tail projected into the cæcum. There were no other lumbrici in the alimentary canal.

Dr. C. F. Brower,\* of Virginia, possesses the specimen, of which a drawing is shown (Fig. 1). The patient, a child of twelve years, presented symptoms of a mild attack of appendicitis. Dr. Brower operated 30 hours after onset of symptoms, removing the appendix with a portion of adherent omentum. The worm, being still in the appendix, was divided by the scissors and half of it then withdrawn from the cæcum. The appendix was gangrenous for an inch and a half at its distal end, and at one point was on the verge of perforation. Recovery was uneventful.

The only foreign body observed in this Hospital in 250 cases was a segment of tapeworm, seen in a fatal case of appendicitis reported by Robb.†

Warren Coleman,‡ in a man of sixty-seven, dead of nephritis and pneumonia, found in the dilated appendix a piece of bone five-eighths of an inch long and a quarter of an inch at its broadest part. It had entered blunt end foremost and was enveloped in mucus, completely filling the dilated tip. The thickened walls showed evidence of its presence for a long time, but externally there were no signs of inflammation. This case and that in which the appendix contained 122 shot, together with several that follow, show that, while generally causing very rapidly progressive inflammation, even large and rough foreign bodies can be present in the appendix and give no symptoms at all or can lead to chronic or recurrent appendicitis. Murphy§ also had an acute appendicitis, in which the offender was an enterolith having a spicule of bone as its nucleus. Thompson|| reports a case in which a bone was present. Nathaniel Ward,¶ in 1855, had a patient who died after an acute illness of seven days. At autopsy it was seen that a small worn-down bristle from a tooth brush, a third of an inch long, had ulcerated through the base of the appendix and had given rise to purulent peritonitis. Dr. Schooler,\*\* of Des Moines, removed an appendix containing a wisp of broom and another in which there was a bristle, and Abbe\*\* recently had one containing a piece of corn husk.

In the Gynecological Laboratory of the Johns Hopkins Hospital is a specimen (Fig. 3) which was successfully removed by Dr. W. E. Ashton†† from a woman forty-eight years old. She gave a history of abdominal pain, lasting through three years, and referred to the uterus which was curetted and the cervix amputated. The pain continued and increased, but did not become localized. Examination revealed nothing except a slight general soreness over the entire abdomen. An explor-

\* Stone and Ransohoff: Personal communication.

† Holmes: New England Quarterly Journal of Medicine and Surgery, Boston, 1882-3, I, 257.

‡ Hevin: Mémoires de l'Académie Royale de Chirurgie, 1743, I, 460.

§ Gibbons: West. Lancet, San Francisco, 1873, II, 113.

|| Nelson: British American Journal of Medicine and Physical Science, Montreal, 1846-7, II, 257.

¶ Ulloa y Giralt: Revista mensual médico-quirúrgica de Neuva-York, 1878, I, 28.

\*\* Blackadder: Edinburgh Medical and Surgical Journal, 1824, XXII, 18.

\* Dr. Brower himself expects to publish this case *in extenso* at a later date.

† Robb: Johns Hopkins Hospital Bulletin, 1892, III, 23.

‡ Coleman: Medical Record, N. Y., 1895, XLVIII, 639.

§ Murphy: Journal of the American Medical Association, Chicago, 1894, XXII, 302.

|| Thompson: British Medical Journal, Sept. 23d, 1892.

¶ Ward: Transactions of the Pathological Society of London, 1855, VI, 197.

\*\* Schooler and Abbe: Personal communication.

†† Ashton: Medical Bulletin, Philadelphia, 1894, XVI, 85.



FIG. 1.—Appendix containing a round worm. Removed by Dr. C. F. Brower, Catharpin, Va. (By courtesy of Dr. Halsted.)

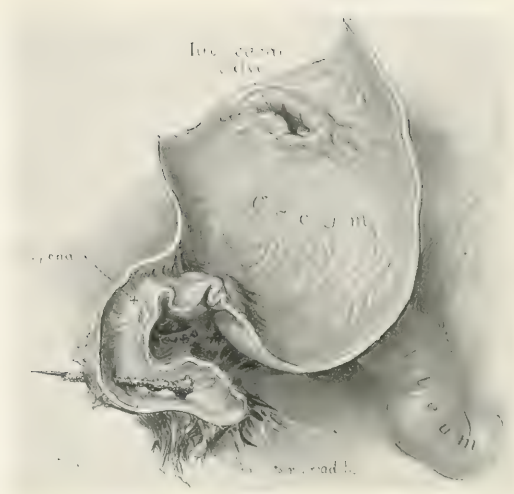


FIG. 2.—Appendix with pin perforating its wall. Removed by Dr. H. D. Rolleston, London, Eng. (Case 27.)



FIG. 3.—Appendix containing a fish fin. Removed by Dr. W. A. Ashton, Philadelphia.



FIG. 4.—Appendix containing three gallstones. Removed by Dr. W. A. Ashton, Memphis, Tenn.



FIG. 5.—Fecal concretion with pin as nucleus. Removed by Dr. Francis H. Markoe, New York. (Case 10.)

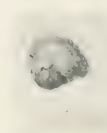


FIG. 6.—Fecal concretion with bullet as nucleus. Removed by Dr. Joseph Ranschoff, Cincinnati, O.





atory abdominal incision was made, and the appendix, which was adherent to the brim of the pelvis, was removed. In it was the fin of a fish which, through pressure, had caused circulatory changes and ulceration.

#### PINS IN THE APPENDIX.

Conspicuous among pointed bodies and occurring with apparently greater frequency than any others are pins. Abbe,\* in his large experience, has met with only two foreign bodies, and one of these a pin. Roswell Park† and McBurney‡ had each two cases, and numerous instances are to be found scattered through the literature. The earliest probable case we have encountered is described by Ruysch,§ of Amsterdam, in 1691. A young girl had swallowed a pin. Some time afterwards a hard inflammatory tumor appeared in the groin accompanied by fever and acute pain. Soothing applications having been used and suppuration induced, an incision was made in the tumor, and in the pus and fecal matter evacuated was a rusty pin. ("Statim simul cum pure copioso acicula ærugino abducta prodit, non sine excrementorum alvinorum commixtione . . . non est dubitandum, quin in principio, suborta inflammatione, intestinum, ab aciculæ mucrone læsum arcu connatum fuerit peritoneo.")

After a careful search we have collected twenty-eight other cases in which a pin was found in the appendix at operation or at autopsy, together with two instances in which a pin had perforated the cæcum.

In no single case has there been any knowledge of swallowing a pin and no explanation is offered for their presence.

Contrary to what might be expected, they occur more often in males than in females (males 17, females 9). Many are in of children under ten years of age; one in a boy of fifteen months; others in adults in various occupations and conditions of life.

One would naturally suppose that such a foreign body in the appendix would lead to rapid perforation; but, while this is generally the case, it is not always so. All types of appendicitis may result. Some give rise to only mild symptoms and may lead to chronic appendicitis (7 cases) with recurrent attacks, or with long-continued pain, or only a feeling of uneasiness in the right iliac region, which may last for months or years, and perhaps finally end in an abscess (Cases 14 and 15). Most often, however, there is rapid perforation and abscess formation following the first appearance of symptoms.

The pin may enter the appendix by its head or point. It is generally straight, lying in the lumen of the appendix with its long axis parallel to that of the appendix, and perforating with its point (Fig. 2). In one or two instances, however, it lay directly across the lumen and perforated with its head one wall, with its point the opposite. Dr. McBurney removed an appendix which contained two pins lying side by side and

perforating the opposite walls of the appendix in this manner (Case 8).

On two occasions the pins have been found in appendices contained in hernial sacs.

The pin may be free from deposit, rusty or corroded. Usually, however, it is the nucleus of a fecal concretion which covers the head and most of the shaft, leaving the point free. Such a body is shown in the accompanying cut (Fig. 5) from a case operated upon by Dr. Markoe (Case 10).

An interesting feature of this collection of cases is the frequent association of abscess of the liver, which was observed in seven of the twenty-eight.

From our investigation we can draw the following conclusions, supported by statistics:

Foreign bodies, at one time thought essential in appendicitis, are now known to play a much smaller rôle than that formerly accredited to them; and fecal concretions are much more apt to be present as an exciting cause.

While many curious and unexpected things are occasionally found, the appendix nevertheless would seem to act especially as a trap for pointed bodies and for small heavy objects like shot or bullets.

Conspicuous among pointed bodies are pins, and their presence is by no means uncommon.

Those foreign bodies of *light weight*, like grape seeds and cherry stones, so popularly assigned as the cause of appendicitis, and against which we are forever being warned, are in reality exceptional, and their frequency is much overestimated on account of the close resemblance of fecal concretions and the lack of careful examination of the bodies described.

The following cases, recorded in the literature and communicated privately, warrant the assertion that the pin is one of the commonest and at the same time the most dangerous of all foreign bodies.

#### CASES.

(1) *Mentivier* (1757): *Jour. de Méd. Chir. Pharm., etc.*, 1759, X, 441.

A man, aged 45, presented himself with a large fluctuating tumor in the right side of abdomen near the umbilicus. It was opened and a pint of very foul pus evacuated. He died. At autopsy: "The cæcum presented nothing extraordinary. Here and there were gangrenous ulcers. Scarcely was the appendix opened, however, when there was found a large pin all encrusted and so eroded in places that the least force would have broken it."

Although the man had never mentioned swallowing a pin it was easy to conceive that it had long been shut up in the appendix, and by irritating the various coats had caused the trouble leading to death.

(2) *Parrot* (1855): *Bull. Soc. anat. de Paris*, 1855, 54.

Man, aged 24. Twelve years ago had pain in right inguinal region with the development of a tumor in the right iliac fossa. Eight years later the tumor made sudden progress. A year ago it was considerably increased and there were general symptoms and acute pains. An abscess opened and discharged considerable bloody pus. Patient was admitted with a fecal fistula in lower right abdomen in which the probe encountered something hard. An incision was made and this body extracted with great difficulty. It proved to be an ordinary pin with the point free and otherwise enveloped in solid fecal matter. The patient died with general peritonitis. Autopsy showed the fistula leading into a cavity into which opened the appendix.

\* Abbe: Personal communication.

† Park: Medical Record, New York, 1895, XLVII, 345.

‡ McBurney: Personal communication.

§ Ruysch: *Observationum Anatomico-Chirurgicarum, Amsterdam, 1691, Observatio LV, 71.*

Patient did not remember swallowing a pin.

(3) *Joffroy* (1869): Bull. Soc. anat. de Paris, 1869, XLIV, 512.

Girl, aged 10. Admitted with pain in right groin, radiating through abdomen, diarrhoea and incessant vomiting. Two days later tumor in right flank, which disappeared in a few days. Later, multiple superficial abscesses. Death in two months.

*Autopsy*: Circumscribed abscess in right iliac fossa with a collection of pus. In the appendix was found a pin of large size which had entered head first and had penetrated with its point the appendix wall. The pin was surrounded by faecal matter.

(4) *Payne* (1870): Trans. Path. Soc., London, 1870, XXI, 231.

Woman, aged 37. Illness of three weeks; headache; abdominal pain; tenderness; bowels regular; temperature 104°; delirium and death.

*Autopsy*: Lodged in the appendix was a medium-sized black pin, the head and three-quarters of shaft surrounded by a faecal concretion making a mass an inch long. The bare point of the pin projected into the caecum. The appendix walls were thickened but there were no signs of acute inflammation. No general peritonitis. Abscesses of liver and lungs.

(5) *Legg* (1875): St. Barth. Hosp. Rep., London, 1875, XI, 85.

Girl, age 5. History of bronchitis, measles and scarlet fever, the last followed by an abscess in right groin which was poulticed and opened spontaneously. Child was well for a time and then wasted. Abscess developed in epigastrium; was opened, discharged great deal of pus; healed. Twelve days later abdominal distention, vomiting, death.

*Autopsy*: Multiple abscesses among intestines. Abscesses of liver. Appendix adherent to caecum was cut across and a black pin was noticed which apparently came out of the gut; rusty on its head and upper third. On dissecting out the appendix, a round hole the size of a split pea and black around its edges was found to open from the appendix into peritoneal cavity close to caecum.

(6) *Whipham* (1879): Trans. Clin. Soc., Lond., 1879, XII, 58.

Boy, aged 18. Five months before admission had an illness of six weeks; pain in side and diarrhoea. Seven days before admission pain in right side, shooting to axilla; next day bent with pain; sixth day vomiting, diarrhoea, abdominal tenderness; no tumor.

*Operation*: Incision; drainage tube in chest.

Few days later acute abdominal symptoms and death.

*Autopsy*: Localized abscess in right iliac fossa extending to sacrum and bladder; purulent and faecal contents. Free in abscess cavity was a pin an inch and a half long. The appendix, doubled on itself, was perforated at opposite points in the fold. Appendix adherent to caecum with a perforation into caecum.

(7) *Ashby* (1879): Lancet, London, 1879, II, 649.

Girl, aged 8. Four months' illness; type of appendicitis. Pain in right side; legs drawn up; temperature 105°. Death.

*Autopsy*: Large abscess of liver. Appendix contained a pin encrusted with phosphates and its point sticking through appendix wall. Near this spot was a ragged ulcer with its base adherent to parts around.

No history of swallowing pin.

(8) *McBurney*, New York (1888): (Personal communication to Dr. Kelly.)

Boy, aged 10. Patient for some time had had what appeared to be an inflamed irreducible right inguinal hernia, the contents of which were thought to be omentum. At operation the contents were found to be a much-inflamed and thickened bulbous appendix, the enlarged distal end being about an inch in diameter. In this mass, the points piercing one side and the heads the other, were two black pins which lay close together. The appendix was amputated and the case finished as one of hernia. Recovery.

(9) *Baker* (1889): Brit. Med. Jour., 1889, 1347.

Man, with symptoms of intestinal obstruction and swelling in right iliac fossa.

*Operation*: Median incision and evacuation of foetid pus. Six weeks later peritonitis and death.

*Autopsy*: A pin was found with its point protruding through the appendix, and its head buried in a mass of faecal matter which could not be removed.

(10) *Francis N. Markoe*, New York (1892): (Personal communication to Dr. Kelly.)

Boy, aged 4. Child always well till four months ago. At that time had what his physician said was an acute attack of appendicitis, and an abscess was formed in the right iliac fossa, which opened spontaneously and left a discharging sinus. On admission there was found a sinus with several openings just below and to the inner side of the anterior superior spine. A probe passed an inch and a half downwards and backwards. Discharge had a faecal odor.

*Operation*: Sinus curetted. No result. A few weeks later it was laid open, and a pin with a concretion about its middle was removed. No further attempt was made to explore the region. The appendix was not seen. After a short time the wound healed.

(11) *Shoemaker* (1892): Trans. Coll. Phys., Phila., 1892, 3 s., XIV, 214.

Male, aged 18. Illness of twelve days; chill; pain in right side; constipation; faecal vomiting and subnormal temperature; abdomen tense and edematous; no tumor; no jaundice.

*Operation*: Incision in the right semilunar line. General purulent peritonitis. Death next day.

*Autopsy*: General peritonitis. Ruptured hepatic abscess. Appendix not ruptured, but gangrenous and containing a common pin head downward.

(12) *Bell* (1894): Canada Med. Rec., November, 1894.

Boy, aged 6. Usual signs and symptoms of appendicitis. Two days' illness. Operation and recovery. On opening the appendix a pin was found lying transversely in its lumen, near the tip. The head of the pin had ulcerated through the wall of the appendix, and the point had nearly perforated the opposite side, and at this point the appendix was strengthened by a mass of adherent omentum.

(13) *Willard and Lloyd* (1894): Trans. Path. Soc. of Phila., 1894, XVII, 40.

Boy, aged 9. While under treatment for spinal caries developed acute abdominal symptoms; vomiting, abdominal pain and irregular temperature; legs drawn up; anxious expression.

*Operation*: Sixth day. Incision and drainage of abdominal abscess; collapse; death.

*Autopsy*: General peritonitis, with adhesions. Multiple abscesses of liver. Appendix perforated at a point near its base. Around this perforation were signs of inflammation. On laying appendix open it was found to contain a large black pin with its head toward the cul-de-sac, and its point projecting from the opening.

(14) *Park* (1895): Med. Rec., N. Y., 1895, XLVII, 345.

Man, age 32. History of indefinite discomfort in right iliac fossa for five years, with acute attack of one week's duration.

*Operation*: Appendectomy. Extensive abscess. In appendix was a faecal concretion three-quarters of an inch long and of the diameter of a lead pencil. Imbedded in it was a common pin with the point protruding. Drainage; recovery. Patient denied all knowledge of having swallowed a pin.

(15) *Park* (1895): Med. Rec., N. Y., 1895, XLVII, 345.

Girl, aged 15. Vague and indefinite discomfort for months in right iliac fossa. Finally symptoms of acute appendicitis with temperature and abdominal rigidity.

*Operation*: Incision parallel to Poupart's ligament. Three or four ounces of foul pus. Appendix not found, but a pin in the pus; drainage; recovery.

(16) *McPhedran and Craven* (1895): Canad. Pract., 1895, XX, 180.

Male, aged 21. Pain in abdomen and chest; temperature 103°; chills almost daily for six weeks; temperature sometimes reaching



106.4°. Aspiration of chest; no pus. Later, pus in ankle-joint. Four months later coughed up six ounces of pus. Pyuria. Death.

*Autopsy:* Small abscess of liver communicating with abscess in right pleural cavity, and this with a bronchus. Other liver abscesses. Appendix thickened and dilated. About its middle was a distinct cicatricial contraction and in the dilated extremity beyond lay a large-sized common pin. It was bent at an obtuse angle and its tip was imbedded for an eighth of an inch in the appendix wall. The pin was largely covered with a layer of calcareous matter laid down in a regular coat.

(17) *Colmer* (1895): *Lancet*, Lond., 1895, I, 745.

Boy, 7½ years of age. Three days' illness with vomiting, constipation and abdominal pain ending in sudden death. No history of swallowing a pin.

*Autopsy:* Signs of recent general peritonitis especially about the cæcum. Appendix thickened, enlarged and perforated, and through the perforation projected a sharp point. On opening the appendix there was found a body much like a date stone composed of fecal matter enclosing a pin with the point projecting.

(18) *Abbe*, New York (1895): (Personal communication.)

Child, aged 5. Operation. Appendix had been perforated by a pin which had ulcerated out and was in an abscess cavity, of which the sloughing appendix was the centre. The pin was considerably encrusted with salts.

There was no history of the pin having been swallowed.

(19) *Kammerer* (1895): *Annals of Surgery*, 1895, XXII, 274.

Boy, aged 7. Illness of a week. Tumor in right side of abdomen.

*Operation:* Laparotomy. Tumor in omentum. On separating some adhesions it was found that the distal half of the appendix was firmly embedded in the mass, and that an ordinary pin had passed through almost the entire length of the appendix, and had escaped through a perforation at the tip. There were very firm adhesions of appendix to the omentum showing that this could not have been the first attack.

(20) *McBurney*, New York (1896): (Personal communication to Dr. Kelly.)

Man, aged 29. Five days before admission was suddenly taken with cramps in abdomen, general at first, but soon confined to right iliac fossa. Patient up and about; stoops to right to relieve pain. Tenderness over right iliac region. No tumor. Dulness over Poupert's ligament. Temperature 98°, pulse 80.

*Operation:* Incision over tumor, which was made out under ether and an ounce and a half of pus evacuated. In the abscess cavity a large soft concretion was felt. On attempting to remove it, it was found to be very friable and crumbled, showing an ordinary pin as the nucleus. The appendix had sloughed off near its base. Recovery.

(21) *Syms* (1896): *Annals of Surgery*, 1896, XXIII, 604.

Woman, aged 21. Good health till seven years ago, when she first had symptoms of appendicitis with a large abscess which opened spontaneously and healed. Repeated similar abscesses for six years. Finally a large abscess which was opened and drained. Second operation for persisting sinus showed tip of appendix attached to fascia under which was a cavity to which sinus led. In the appendix was found a toilet pin, the head of which was the nucleus of a hard fecal concretion.

(22) *Roberts* (1896): *Am. Pract. and News*, Louisville, 1896, XXI, 491.

Boy, aged 15 months. Strong baby, bottle-fed. Illness of one day; vomiting; diarrhoea with bloody stools. After the last action a tumor appeared on right side of scrotum, which proved to be a strangulated hernia.

*Operation:* The cæcum with the appendix formed the hernial contents. On lifting up the appendix a pin was seen protruding from its posterior wall. It had passed through the sac into the

dartos of the scrotum, the head being in the end of the appendix. Appendix removed and cæcum returned. Recovery.

(23) *Deaver* (1896): *A Treatise on Appendicitis*, 1896, 36.

Woman, aged 33. Ten days before operation sudden sharp pain in right side with vomiting for two days. Pain persisting for a week with tenderness and rigidity. Mass in right iliac fossa size of orange, not painful. Temperature 103°.

*Operation:* Appendectomy. No pus. Omentum adherent. Appendix contained a black pin which had entered the canal point first.

(24) *Daland* (1897): *Proc. Path. Soc., Phil.*, 1897, n. s. I, 55.

Adult male. For a number of months pain in appendic region. On admission typical symptoms of acute appendicitis of ten days' duration. Tenderness and rigidity.

*Operation:* Appendectomy. Eight ounces of pus evacuated from abscess cavity. Recovery.

An ordinary pin was found occupying the lumen of the appendix and, although causing no perforation, there were evidences of chronic appendicitis, shown by considerable thickening of the walls, partial encapsulation and presence of adhesions. The pin had become almost black in color.

No history of swallowing a pin.

(25) *Lee* (1897): *Lancet*, London, 1897, II, 536.

Woman, with history of sudden seizure with violent pain in abdomen. Death soon after.

*Autopsy:* A pin was found in the appendix, the point of which had evidently fretted its way through the end of the appendix. The opening thus made communicated with an abscess in the peritoneal cavity.

(26) *Officer* (1898): *Intercol. Med. Jour.*, of Austral., 1898, 229.

Boy, aged 6. Ill nine days; headache; drowsiness; vomiting and fever; abdominal pain. No tumor. Two days later abdominal distention and legs drawn up.

*Operation:* Laparotomy. Peritoneal cavity full of pus. Irrigation and drainage. Death in 36 hours.

*Autopsy:* General peritonitis. Appendix found with difficulty, and on attempting to cut it out an ordinary pin was encountered, which had ulcerated through the wall of the appendix and was lying partly across its lumen.

(27) *Rollston* (1898): *Trans. Path. Soc., London*, 1898, XLIX.

Girl, aged 7. Stitch in right side for a year or so. Five weeks before death signs of right pleurisy. Fever. Later, operation for abscess of liver with evacuation of pus. Death from asthenia.

*Autopsy:* Appendix adherent to broad ligament and surrounded by recent fibrinous peritonitis, appendix cut open, and at the point where it was so firmly adherent a pin was found with its head inside the tube, lying transversely to the long axis of the appendix. The shaft and tip of the pin after passing through the wall of the appendix were surrounded by old adhesions. The whole of the pin was irregularly encrusted with calcareous matter. Abscesses of liver.

(28) *Keen* (1898): *Trans. of Am. Surgical Assoc.*, 1898.

Man, aged 24. When seven years old he had a great deal of trouble in passing urine, and when examined by the family physician, a pin was found well down in the urethra. He does not remember that he inserted it, and believes he swallowed it.

In March, 1896, it was supposed that a recto-vesical fistula was established following a prostatic abscess, and food was frequently recognized in the urine.

In April, 1897, after two unsuccessful operations for the closure of this fistula, laparotomy was finally performed. A long appendix was detected, the tip of which was solidly incorporated into the bladder, thus acting as a third ureter and discharging feces instead of urine into the bladder. The appendix was separated from the bladder and removed, and the patient recovered, but later died of intestinal obstruction due to a volvulus.

The two cases which follow are so much like those under consideration as to deserve being included with them. In these the cæcum instead of the appendix was perforated by a pin, and the clinical picture was that of appendicitis.

(29) *Boussi* (1878): Bull. Soc. clin. de Paris, 1878, II, 15.

Woman, aged 40. Three weeks before admission, during and after menstruation violent abdominal pain and fever. Admitted with tumor in right iliac fossa, semi-ductuant and tender; chills and vomiting. Death in sixteen days.

*Autopsy*: Abscess beneath liver communicating with abscess in right iliac fossa. In the pus was a blackened pin, which had perforated the cæcum.

Patient did not remember swallowing a pin.

(30) *Southam* (1893): British Medical Journal, Apr. 30, 1893, 1130.

Man, aged 29. Admitted with symptoms of acute appendicitis. Four days previously sudden pain in right iliac fossa with vomiting. On admission there was fulness above Poupart's ligament, tender and dull on percussion; rigidity of abdominal walls. Attack subsiding at end of a week. On ninth and tenth days fecal vomiting.

*Operation*: Incision over appendix. An ounce of thick foul pus evacuated in which was a fecal concretion, ovoid in shape and three-quarters of an inch long. In the centre of this was a pin with the head and point protruding. Drainage. Recovery with fecal fistula.

At a second operation, three months later, there was found a fistulous opening in anterior wall of cæcum three inches from origin of appendix. Appendix perfectly healthy. Fistula sutured. Recovery.

Five additional cases have come to our notice too late to be included in the substance of this paper, which thus make thirty-three instances in which we have found a record of the presence of a pin in the vermiform appendix.

One is especially interesting, in that it is the only case in which there is any history of swallowing a pin.

Another makes an eighth instance of the association of liver abscess with appendicitis.

(31) *Robert P. Harris*, of Philadelphia, in a personal communication to Dr. Kelly recalls a case seen by Dr. Wm. Pepper, Sr., in consultation with Drs. Hugh Hodge and Meigs, where Dr. Pepper differed from his consultants and made a diagnosis of peritonitis. The woman died of peritonitis, and at the autopsy "a pin was found sticking through the end of the appendix, the cause of the peritonitis."

(32) *Harley* (Diseases of the Liver. London, 1883, 846):

Boy, aged 19. Admitted with fever; a rapid pulse, and tenderness over liver. Death in nine days.

*Autopsy*: Large abscess of liver. At the very apex of the appendix was a thick brass pin an inch and a quarter long, the head somewhat green and eroded, pointing downwards, and projecting through the caudal extremity of the appendix. A drop or two of pus was found outside of the peritoneum.

(33) *Schooler*, Des Moines, Iowa (1895): (Personal communication to Dr. Kelly.)

Man, aged 48. While pitching hay felt uneasiness in right side of abdomen, which later increased to pain. On second day a large tumor in the region of the appendix was made out. An incision was made and a quantity of pus escaped. Wound packed. On the third day the packing was removed and an opening seen in the bottom of the wound. The finger introduced in this felt a sharp point, which proved to be a pin, surrounded by pus. It was withdrawn with forceps. The appendix was not seen.

(34) *Schooler*, Des Moines, Iowa (1898): (Personal communication to Dr. Kelly.)

Girl, aged 2. Had been complaining for several days. Under anesthesia a decided swelling was made out in the region of the appendix.

*Operation*: Incision into abscess. Evacuation of three ounces of pus. A pin was found sticking through the wall of the appendix, the head remaining inside. Appendix removed and wound packed. Recovery. The child had swallowed a pin several months before.

(35) *Harlow Brooks*, New York (1899): (Personal communication.)

Woman, aged 54. Illness of a week; headache and general pains; incontinence of urine and feces. Diagnosis of "epidemic influenza, complicated by broncho-pneumonia." Death in ten days.

*Autopsy*: Diagnosis of broncho-pneumonia verified. The appendix was 8 cm. long; its tip dropped down into the pelvic cavity and was adherent to the right ovary which had become almost completely transformed into a cyst. Just at the centre of the appendix, where there were dense adhesions to the psoas muscle, there was a small cavity enclosed by the surrounding cicatricial tissue and containing pus and feces. This abscess communicated with the lumen of the appendix. Lying in the proximal portion of the appendix, with its head at about the location of the abscess, was an ordinary pin encrusted with lime salts and fecal matter. The pin lay with its head down, the shank extending up in the lumen of the appendix.

## ORIGIN, DEVELOPMENT AND DEGENERATION OF THE BLOOD-VESSELS OF THE OVARY.\*

(From the Anatomical and Gynecological Laboratories of the Johns Hopkins University.)

### PRELIMINARY STATEMENT.

AN ANATOMICAL AND PHYSIOLOGICAL STUDY OF THE VASCULAR SYSTEM OF THE OVARY AND ITS INFLUENCE UPON THE SUCCESSIVE STAGES AND ACCOMPANYING PHENOMENA OCCURRING IN THE EVOLUTION OF THE GRAAFIAN FOLLICLE. ALSO A CONSIDERATION OF THE RELATIONSHIP OF THE CORPUS LUTEUM TO THE CONSERVATION AND TO THE FINAL CESSATION OF OVULATION.

By J. G. CLARK, M. D., Late Resident Gynecologist in the Johns Hopkins Hospital, Associate in Gynecology in the Johns Hopkins University.

In February, 1896, at the suggestion of Prof. Mall, I began the study of the ovarian circulation, with a view of determining the normal distribution of the arteries and veins of the ovary

and their relationship to each other. At first sight the solution of this question did not appear to present greater difficulties than those encountered in the ordinary course of any research. A study of the sections of a few injected adult ovaries, however, at once demonstrated the futility of attempting to draw any conclusion from this source, for the close crowding

\* Presented before the Johns Hopkins Medical Society, December 19, 1898.



together of the parallel vessels of the medullary portion, and the markedly irregular course of those in the cortex or follicle-bearing zone, rendered impossible any accurate observations concerning the relative number and distribution of the veins and arteries, and the exact course followed by each system.

With a view, therefore, of securing ovaries possessing a simpler scheme, a study was made of the lower animals, such as the dog, rabbit, guinea-pig, sheep and pig, but with unsatisfactory results, and only after the injection of the generative organs of a monkey was a suggestive clue secured. Beyond this point, however, it was difficult to proceed, and only after the injection of a very large series of ovaries from individuals, ranging in age from a six-months foetus to a woman many years beyond the menopause, were final conclusions reached.

In the search for this normal scheme through an extensive number of serial sections, various questions directly dependent upon the circulation have presented themselves for solution, which have widened the scope of this work until it has developed into a composite anatomical and physiological research.

Thus the various vital phenomena have been considered which transpire within the follicle from its embryological origin and progressive growth to the time of its disappearance, either through an obliterative process or through its rupture, organization as a corpus luteum and final retrogression as a corpus fibrosum. In this connection theories have been suggested as to the cause of ovulation, the synchronism of ovulation and menstruation, the mechanism of the rupture of the mature follicle and the final cessation of ovulation, which have been based upon observations made in the study of a very large number of sections.

Soon after beginning this work I was struck not only with the difficulty of arriving at a definite knowledge of the scheme, but also of determining the age at which this scheme may be taken as a standard for comparison.

This is certainly not possible after active ovulation is established for the constant changes in the vascular system induced through the maturation, rupture and organization of the follicle, introduce an element of variability into the circulation of this organ which, so far as I know, occurs in no other.

Failing to reach any satisfactory starting point in the adult, the ovary of a girl approaching puberty was next studied, but with little less success, for it was found that almost as constant variations occur in the follicular circulation before as after the inauguration of ovulation. In the hope of finally reaching a period in the life of the female individual, at which a definite standard for comparison might be found, numerous specimens from children of various ages were injected and closely studied. Finally the ovary of a six-months foetus was obtained, which furnished a definite clew as to the arrangement of the vessels, but as the follicular apparatus was still in process of development a new-born child in which the tunica albuginea was well formed was selected as the standard. Even here the solution of the question was not easy, for in order to trace the ramifications of the vessels from the point of their entrance into the ovary to their ultimate termini the study of the serial sections of many ovaries was necessary.

To briefly summarize the chief points in this investigation I have considered them under a skeleton outline, the main headings of which will conform in general to the arrangement in my forthcoming paper.

In this preliminary statement it is impossible to more than hint at the points which will, in the final publication, be developed through schematic demonstrations and many drawings from injected specimens, and for the same reason references to the numerous researches which have been made upon many of the subjects considered in this report must be omitted.

#### EMBRYOLOGICAL CONSIDERATIONS.

The primitive circulation of the Wolffian body will be dwelt upon, and an explanation of the origin of the spermatic vessels as an independent system from that of the former will be offered. As is well known among embryologists the Wolffian and Müllerian ducts are well formed and the germinal eminence is of considerable size before visible signs of the differentiation of sex become manifest. Up to this point the embryo is said to be of the hermaphroditic or indifferent type.

In retracing the steps of development from the well-formed embryo back to this period some very interesting points concerning the differentiation of sex have been secured. The radical differences existing between the vascular system of the testicle and ovary have furnished a valuable sign for determining the gender of very young embryos, before the external differential marks are established.

The fact to which attention will be directed especially is that the testicular circulation is peripheral, the main artery of which courses over the dorsal aspect of the organ, giving off in its course rib-like branches which in turn send penetrating branches into the gland. Between the arteries are situated the collecting veins which unite at the base of the testicle to form the spermatic plexus.

In the ovary this scheme is exactly reversed, the arteries with their accompanying veins entering the center of the organ where they branch tree-like and terminate as a fine capillary anastomosis in the tunica albuginea.

Upon the peculiarities of each circulation the differential signs of sex are based—a visible dorsal vessel always indicating a male; an alabastic-like non-vascular white cortex a female embryo.

In microscopic sections the presence of large peripheral vessels also indicates the male, whereas large central vessels indicate the female sex.

The significance of the vascular arrangements in the testicle and ovary will also be discussed from the physiological standpoint, and to the radical differences existing between them will be ascribed the persistence of the testicular function in the male to old age, and the comparatively early abrogation of ovulation in the female. In the testicle the production of sperma is a more or less fixed and constant function like that of the pancreas, the parotid and other secreting glands, consequently the circulation is not subject to variations and is only interrupted through disease or through senile changes, whereas in the ovary there is a constant variation in the circulation incident to the obliteration or disappearance of follicles and the compensatory production of connective tissue which sooner or



later begins to limit the peripheral circulation, and this in turn leads though secondary influences to a final cessation of ovulation.

Incidentally, I may remark that these wide differences in the circulation lead me to the conclusion that the origins of the ovary and testicle are not as generally believed the same, but are totally different, and that the expressions "asexual period," "hermaphroditic stage of the embryo," etc., merely serve to mask our inability to select the differential features of the sexes back of this point.

In view of the fact that the common progenitor of the ovary and testicle is the Wolffian body and that the atrophy or degeneration of the latter is coincident with the active growth of the former, an endeavor has been made to discover the explanation of this apparent paradox. According to my observations upon this point, it lies in the fact that the vascular system of the sexual glands originates entirely independently of that of the Wolffian body, consequently the synchronous development and degeneration of the two sets of organs is possible.

Having traced the development of the circulation in the ovary and testicle from the so-called asexual period to the point where they have formed systems diametrically opposite in their distribution and ultimate arrangement, the further consideration of the testicle will be dropped and the study of the ovary along the line of its development and progression to its ultimate history will be pursued.

#### DEVELOPMENT OF THE GRAAFIAN FOLLICLE.

My study leads me to reject the Valentine-Pflüger theory concerning the origin of the follicle and to accept, with some reservation, the general scheme of development as suggested by Waldeyer. So far as the genesis of the "egg nests" and their ultimate subdivision into follicles are concerned, I am in accord with the latter investigator, but as to the origin of the so-called follicle epithelium or *membrana granulosa*, I feel that the evidence in my hands is sufficient to put me at variance with Waldeyer's conception and to incline me towards that of Foulis, who believes that the germinal epithelium only forms ova and that the lining membrane of the follicle is derived from the connective tissue stroma.

#### THE OVARIAN CIRCULATION OF THE NEW-BORN CHILD.

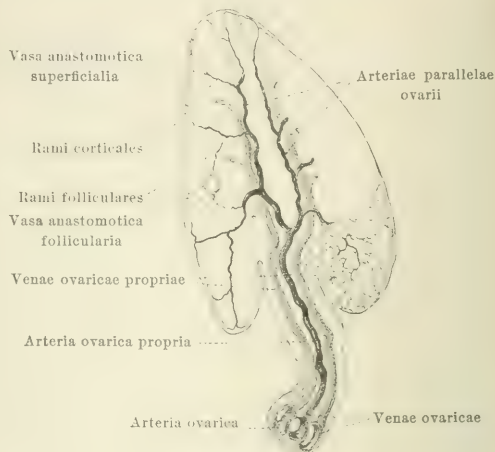
With the completion of the fibrous covering of the ovary (*tunica albuginea*) shortly after birth, the vascular system becomes fully developed, and this period, therefore, may be said to represent the typical scheme, for up to this point there has been no derangement of its central or peripheral branches, which will occur later through the progressive development and degeneration of follicles.

The secondary branches of the circulatory tree occupy a comparatively small medullary area, its tertiary branches being given directly off into the follicle-bearing zone. The follicles are, as a rule, still in their primitive state, only a few of the many thousands as yet showing progressive development.

Even at this early period, however, isolated follicles undergoing progressive and retrogressive changes may be noted. These changes, as I shall hope to show, are closely analogous

to if not identical with those occurring in the ovaries of older children, and in women after ovulation is inaugurated.

The arrangement of the circulation as established at this early age is shown in the following schematic way:



As will be seen from this sketch each follicle is provided with a vascular wreath, which is formed by the terminal twigs of the main cortical branches.

The development of this wreath and its final obliteration, along with the disappearance of the corpus luteum, does not affect the general scheme, for it merely represents one small terminal system, the destruction of which, so far as its effect upon the general system is concerned, is like the lopping off of an ultimate twig of the branch of a large tree.

For this reason the changes in the ovarian circulation incident to the progressive development and degeneration of the follicles, even in early womanhood, are local and not general. It is only in the later periods of the ovulating life of the female that the latter effect is noted. Beyond the follicular zone the terminal vessels break up into capillaries which form a fine parallel running anastomosis in the *tunica albuginea*, which hitherto has not been described.

The extensive anastomosis throughout the ovary renders easy the shifting of the circulation from one set of vessels to another, consequently the destruction of the function of the ovary is almost an impossibility before its final cessation through natural causes.

In the same way the persistence of the function in even tiny bits of the ovary, which are occasionally left after an ovariectomy, may be explained.

In order to conform to the new method of classification, recently decided upon by anatomists, a system of nomenclature has been adopted which is based upon the regional distribution of the vessels.

## CLASSIFICATION OF VESSELS:

ENGLISH.	LATIN.
Ovarian artery.	Arteria ovarica.
“ veins.	Venæ ovaricæ or Vv. ovaricæ.
Extra ovarian or hilus branch } of artery.	Arteria ovarica propria or Aa. ovaricæ propriæ (Ramus I, II, III, IV, V).
Extra ov., or hilus branches of } veins.	Venæ ovaricæ propriæ.
Medullary branches.	Rami medullares or arteriæ parallelae ovarii.
Cortical branches.	Rami corticales.
Peripheral anastomosis.	Vasa capillaria anastomotica su- perficialia.
Follicular branches.	Rami folliculares.
“ anastomosis.	Vasa anastomotica follicularia.
Utero-ovarian anastomosis.	Arteria anastomotica uterina.

In order to follow the progressive changes in the ovary from birth to the climacteric, specimens from my collection representing the following ages have been selected: child of 2 years, girls of 9 and 12 years, and of 14 years, just after the establishment of ovulation, young woman of 24 years, middle-aged woman of 35 years, woman approaching the menopause at 42 years, and finally an old woman of 66 years, long after the menopause.

In these specimens an endeavor has been made to follow not only the changes incident to the circulatory system, but also the other progressive histological transformations.

The comparison of this ascending series has suggested certain hypotheses concerning the physiology of the ovary, which I trust have been strongly sustained, if not confirmed, by the specimens in hand.

## THE OVARY OF A CHILD OF TWO YEARS.

In the six-months fœtus the main branches of the ovarian artery correspond in the general form of their distribution to the fasciculi of a widely spread folding-fan, the divisions between the arteries being filled with primitive follicles.

As the ovary grows in age the vessels with the connective tissue septæ, which form these divisions, change from a gently curved to a perpendicular course, the branches occupying the medullary portion being crowded into parallel lines (arteriæ parallelae ovarii).

In the two year old child, through the development and retrogression of numerous follicles from birth up to this time, the medullary area comprises a much larger portion of the ovary than that noted in the new-born.

As there is no increase in the number of follicles after birth the obliteration of each primitive or partially developed one naturally decreases the total original number, which results in an increase in the medullary portion of the ovary at the expense of the follicle-bearing or cortical zone.

The law of development in the follicle is from within outward, that is the primitive follicles lying nearest the central circulatory tree are the first to undergo development.

In the young child the developing follicles instead of moving towards the periphery, as occurs in the girl approaching puberty or in the adult, tend to maintain their primitive position, their enlargement being simply centripetal without any attempt at mobilization.

Having reached a certain stage in their development, a retrogressive change following the degeneration of the ovum is inaugurated; and the original site, occupied by the follicle, is replaced by a very minute addition of connective tissue to the stroma of the organ, which naturally builds up through successive accumulations the central area.

Follicles in various stages of development and retrogression are noted in all ages after birth, and according to my observations the same principle involved in the obliteration of the unruptured follicles before puberty governs the organization of the corpus luteum after ovulation is inaugurated.

Briefly stated the changes consist in an increase in the vascular wreath around the primitive follicle and a coincident or dependent hyperplasia of the membrana propria and an accumulation of liquor folliculi.

What determines the cessation of these progressive changes and the beginning of the retrogressive or obliterative process remains unexplained. The fact remains, however, that with the degeneration of the ovum the liquor folliculi is absorbed and the cavity is filled in with large embryonic connective tissue cells arising from the theca interna.

Through the gradual diminution in the blood supplied by the follicular wreath the excess of connective tissue undergoes hyaline changes and absorption until finally only a mere trace of the new-growth remains.

In this way the size of the ovary is maintained within reasonable bounds. Were each mature or large follicle to be replaced by permanent connective tissue, the ovary would very early in life assume the proportions of a new-growth, which sooner or later would constitute fibromata of no mean dimensions.

## PROGRESSIVE CHANGES IN THE OVARY.

In the progressive growth of the ovary the obliterative changes just referred to continue until the follicle-bearing area, reduced by many thousands in its numbers of primitive follicles, becomes a narrow zone compared with its width in the new-born child.

The crowding together in more or less parallel lines of the secondary and tertiary branches of the ovarian vessels is, to return to our analogy, simulated by the partial closure of the fasciculi of the fan. The increase in the internal resistance through the building up of a denser medullary centre and the closer crowding together of the parallel vessels sooner or later breaks the equilibrium of forces and consequently the follicles no longer maintain their primitive position while enlarging but undergo mobilization towards the tunica albuginea, that being the direction of least resistance.

The actual rupture of the follicle, according to my opinion, is due to the influx of blood during the menstrual cycle into the medullary blood-vessels, which has a double action, first to push the mature follicle rapidly towards the surface, and

second, through the increased pressure, to close the parallel running anastomosis in the tunica albuginea, and thus permit a physiological necrosis and rupture of the follicle.

Concerning the question of ovulation and menstruation I shall endeavor to offer further evidence to prove that the rule of synchronism is the normal, and that deviations from this rule are probably due to modifications in the life habit incident to changes in environment and to departures from primitive methods of living and from primitive laws governing sexual congress.

A brief paragraph will be devoted to the processes through which the mature but unruptured follicles undergo obliteration. I shall assume that this is not a pathological condition, but is merely Nature's method of getting rid of a functionless

cavity. The organization of the vascular system of the corpus luteum, followed by its retrogressive changes and final disappearance, will be considered, and I shall take the position that little or nothing of the follicular vascular system remains when the resorption of the corpora fibrosa is complete.

As a conclusion to this study the cessation of ovulation will be ascribed to the gradual impairment of the vascular systems, through first, densification of the ovarian stroma and second, through the retroactive effect of imperfectly removed corpora lutea, which as an end result diminishes the blood-supply to the cortical area to such an extent that the growth of the primitive follicles is retarded and finally completely inhibited. These final retrogressive changes lead up to and constitute the menopause or climaterium.

## OVARIAN CYSTS IN THE NEGRESS.

By THOMAS R. BROWN, M. D.

Comparatively little has been written concerning ovarian cysts in the negress, probably partly because that in most hospitals where extensive gynecological operations are performed the proportion of negro patients is very small, and partly because of the comparative rarity of this condition in negro women.

In fact, one frequently hears surgeons say: "The tumor before us presents all the features of an ovarian cyst, but inasmuch as the patient is a negress it is certainly not so, but a tumor of different origin (cystic myoma, etc.), as multilocular cysts are unknown in the negress."

That ovarian cysts are much rarer in negroes than in white women no one will deny, but as to the exact numerical relationship between the two few if any figures of importance are obtainable, and the object of this note is to give definitely and numerically this proportion as obtained by an analysis of ovarian cysts of various kinds operated upon at the Johns Hopkins Hospital.

In considering ovarian cysts the usual divisions have been made into (a) simple retention cysts, including Graafian follicle and corpus luteum cysts; (b) unilocular and multilocular ovarian cystomata, the two being considered together, as many regard the unilocular cysts as originally multilocular; (c) papillary cysts and (d) dermoid cysts of the ovary; also for sake of completeness parovarian cysts and intraligamentary cysts have been considered.

I shall discuss the frequency of ovarian cysts in the negress first (I) from a clinical and macroscopical standpoint, and second (II) from a microscopical and pathological standpoint, which is much more important.

### I.

An analysis is here given of the various kinds of ovarian cysts occurring in the white and the colored for a period of six years, from January 31st, 1892, until January 31st, 1898, the variety of cyst being determined by clinical observation and macroscopic appearance.

VARIETIES OF CYSTS.

Total No. of cases of all kinds treated at Johns Hopkins Hospital.		Dermoid cysts.		Simple cysts (Graafian follicle and corpus luteum cysts).		Unilocular and multilocular cysts.		Papillary cysts.		Parovarian cysts.		Intraligamentary cysts.	
Wh.	Col.	Wh.	Col.	Wh.	Col.	Wh.	Col.	Wh.	Col.	Wh.	Col.	Wh.	Col.
3996	589	17	7	88	3	53	2	14	0	4	0	3	0

It will thus be seen that out of 191 cysts, only 12 were in the negress, a proportion of 1 : 15, while the proportion of colored to white gynecological patients treated during the same period was 1 : 6.75 (589 : 3996), *i. e.* ovarian cysts were relatively 2.2 times as frequent in white as compared with colored women.

When we analyze the proportion in the different varieties of cysts, we arrive at some striking results.

In the case of the dermoid cysts, cysts due to the inclusion of some of the embryonic ectoderm in the ovarian tissue, we find that 7 of the 24 cases reported were in the negress, *i. e.* 1 : 2.5 (7 : 17), which would seem to indicate that the dermoid cysts are relatively more than twice as common in the negress as in the white woman (the proportion of white to colored gynecological patients being 1 : 6.75).

As regards simple retention cysts, the proportion of 3 to 88 (*i. e.* 1 : 29.3) is probably not a fair estimate, due to the fact that what to call a Graafian follicle cyst and what to call a dilated Graafian follicle depends largely upon the individual operator.

When we consider unilocular and multilocular cysts, however, we are struck at once by their remarkable infrequency in the negress, of the 55 cases mentioned only 2 being in that race, *i. e.* a proportion of 1 : 26.5.

This is of especial importance, because this form of cyst of the ovary grows to the largest size, and it is this variety of cyst which many surgeons declare never occurs in the negress.



No cases were reported of papillary cysts of the ovary, parovarian or intraligamentary cysts in the negress.

Thus it will be seen that with the exception of dermoid cysts, ovarian cysts are really much less common in the colored race, the results, however, being more or less indefinite, due to the fact that the diagnosis was made clinically and macroscopically and not microscopically.

II.

An analysis of ovarian cysts from the microscopical standpoint was made from all cases operated upon in the Hospital from the latter part of 1893 until October, 1898.

During that time there had been microscopically described and diagnosed in the Gynecological-Pathological Laboratory 244 ovarian and parovarian cysts, divided as follows: Dermoid cysts 32, Graafian follicle cysts 68, corpus luteum cysts 16, unilocular and multilocular cysts 94, papillary cysts 10, and parovarian cysts 24.

(a) Dermoid cysts. Of the 32 dermoid cysts, 6 were in the colored, *i. e.* the proportion is 1 : 4.3, showing, as in the clinical study above, that these cysts are relatively more common in the negro race.

CASES OF DERMOID CYST OF THE OVARY IN THE COLORED.

CASES.	PATHOLOGICAL REPORT.	REMARKS.
(1) S.	Dermoid cyst of right ovary, 7 cm. in diameter	Myomatous uterus.
(2) J.	Dermoid cyst of ovary, 16 cm. in diameter	
(3) I.	Dermoid cyst of ovary, 7 cm. in diameter	
(4) S.	Dermoid cyst of ovary, 8 cm. in diameter	
(5) V.	Dermoid cyst of ovary, 4.5x3.5x3 cm	
(6) C.	Dermoid cyst of right ovary, 2.5 cm. in diameter	2 intraligamentary myomata. Myomata uteri.

(b) Retention cysts. Of the 84 simple retention cysts (68 Graafian follicle cysts, 16 corpus luteum cysts), 7 were in the colored, a proportion of 1 : 11, showing that these cysts are relatively less common in the negress than in the white woman (as stated before, the proportion of colored to white gynecological patients being 1 : 6.75).

CASES OF SIMPLE RETENTION CYSTS IN THE COLORED.

CASES.	PATHOLOGICAL REPORT.	REMARKS.
(1) S.	Right unilocular ovarian cyst, probably dilated Graafian follicle, intraligamentary, 9 cm. in diameter.	Double pyosalpinx.
(2) C.	Right corpus luteum cyst, 5 cm. in diameter.	Epithelioma of cervix.
(3) W.	Cyst of ovary from corpus luteum or Graafian follicle, 6x4x4.5 cm.	Double perisalpingitis and perioophoritis.
(4) W.	Corpus luteum cyst, unilocular, 5 cm. in diameter	Myomata uteri.
(5) B.	Cyst of left ovary, 5 cm. in diameter (probably of Graafian follicle).	
(6) B.	Graafian follicle cyst of right ovary, 4 cm. in diameter.	
(7) T.	Right Graafian follicle cyst, 4x3 cm.	Myomata uteri.

(c) Unilocular and multilocular cysts. Of the 91 unilocular and multilocular ovarian cysts, but 6 were in the colored, the proportion thus being but 1 : 14.7, showing that this form of cyst is relatively more than twice as common amongst white women.

It shows, however, that they are by no means so uncommon in the negress as popularly supposed.

CASES OF UNILOCULAR AND MULTILOCULAR OVARIAN CYSTS IN THE COLORED.

(1) G.—Color, black.  
*Pathological Report.*—Multilocular ovarian cyst. Myoma uteri.

(2) H.—Color, black.  
*Examination.*—Abdomen, especially right side, is distended by a firm elastic tumor mass reaching 9 cm. above the umbilicus, its longest axis being 23 cm. In left inguinal region is felt a hard, irregular mass, the size of a small hen egg.  
*Operation.*—Cystectomy. Hystero-myo-salpingo-oöphorectomy.  
The cyst was thin-walled, filled with bloody fluid; it was developed from the outer pole of the right ovary and was entirely retro-peritoneal. The uterus was myomatous, and there were many adhesions, especially about the cyst.  
*Pathological Report.*—Multilocular cyst of right ovary 16 cm. in diameter, springing from the upper pole; the cyst wall is 1 mm. thick, the fluid is dark reddish-chocolate colored. Myomata uteri.

(3) I.—Color, black.  
*Examination.*—Abdomen is much distended in its lower half, and a large mass of irregular outline can be palpated; to the right it feels elastic; to the left hard. The upper border of the mass reaches in the right parasternal line to within 11 cm. of the costal margin. Transversely it measures 29 cm.  
*Operation.*—Cystectomy. Hystero-myo-salpingo-oöphorectomy.  
On the right side a multilocular ovarian cyst posterior to the uterus, filling the cul-de-sac and rising above the pelvic brim, with its walls intimately adherent to the intestines. Myomatous uterus, size of fetal head.  
*Pathological Report.*—Ovarian cyst (either multi- or unilocular, probably the latter); fluid is clear, limpid and yellowish. Myomata uteri.

(4) C.—Color, black.  
*Examination.*—Abdomen is irregularly distended. On palpation a mass, divisible into two separate masses, can be made out, one occupying the lower portion of the abdomen, with irregular outline and nodular surface, the other reaching as high as the costal margin on the left, measuring 9x12½ cm. with smooth surface and elastic feel.  
*Operation.*—Hystero-myomectomy. Cystectomy.  
The cyst was punctured and the fluid withdrawn before the enucleation was started.  
*Pathological Report.*—Left unilocular ovarian cyst, 7 cm. in diameter.

(5) F.—Color, black.  
*Examination.*—The body of the uterus is apparently of normal size and is pressed backwards by a large abdominal tumor, which is firm, elastic, tense, of smooth surface and gives a distinct wave of fluctuation. Corona of resonance is well marked.  
*Operation.*—Cystectomy (left). Right salpingo-oöphorectomy.  
The cyst-wall was punctured, the fluid obtained therefrom being of a muddy brown color. The cyst sprang from the left ovary and was adherent to the omentum. The right tube and broad ligament were plastered over the surface of the cyst. Right salpingitis. The uterus contained a few myomatous nodules.  
*Pathological Report.*—Large multilocular cyst of left ovary, 19x18 cm., containing 1800 c. cm. of dark brown fluid containing much albumen.

(6) H.—Color, black.

*Pathological Report.*—Right multilocular ovarian cyst, 6 cm. in diameter, dense adhesions, cyst of left ovary 5 cm. in diameter, containing blood and débris.

Thus it will be seen that, although these cysts are less common in the negro race, nevertheless they do sometimes occur, and reach as large a size in some cases as the corresponding cysts in the white race, and thus the possibility of their being present should always be seriously considered when the physical examination points in that direction.

(d) Papillary cysts. No case of this kind was found in the negress in the cases analyzed.

(e) Parovarian cysts. Of the 24 parovarian cysts, only 1 was in the negress, showing the extreme rarity of this variety of cyst in this race.

(1) A.—*Pathological Report.* Right parovarian cyst. Myoma uteri. Left salpingitis.

Thus, of the 244 cases of ovarian and parovarian cysts, but 20 were in the colored race, *i. e.* the proportion is 1:11.2, showing that the relative frequency of these cysts is 1.66 times as great in the white as in the colored race.

If we exclude the parovarian cysts, of the remaining 220 true ovarian cysts 19 were in the negress, a proportion of 1:10.6, *i. e.* the relative frequency is 1.57 times as great in the white as in the colored race.

If we exclude the dermoid cysts, cysts which owe their origin to some defect in embryonic development, of the remaining 188 ovarian cysts (corpus luteum, Graafian follicle, multilocular, unilocular and papillary cysts), but 13 were in the colored, *i. e.* a proportion of 1:13.4, showing that these cysts are *relatively* exactly twice as frequent in white women as in colored.

Perhaps the thing that strikes one most in studying these cases is the extreme frequency with which the ovarian cysts in the colored are associated with other pathological conditions, especially with a myomatous condition of the uterus.

In 10 of the 20 cases reported, uterine myomata were also found. These were distributed as follows: In 3 of the 6 cases of dermoid cysts; 2 of the 7 cases of Graafian follicle and corpus luteum cysts; 4 of the 6 cases of unilocular and multilocular cysts; and in the 1 case of parovarian cyst reported.

In 3 of the 20 cases salpingitis, perisalpingitis or pyosalpinx was reported, *i. e.* evidences of inflammatory trouble, distributed as follows: In 2 of the 7 cases of corpus luteum and Graafian follicle cysts, and in the 1 case of parovarian cyst.

Thus, to summarize our results, while the simple retention cysts and the unilocular and multilocular ovarian cysts are seen relatively much less frequently in the negress than in the white woman, they are present relatively much more frequently than is universally supposed; while from both a clinical and pathological study the dermoid ovarian cyst seems to be relatively more frequent in the negro race.

## ON A HITHERTO UNDESCRIBED PEPTONISING DIPLOCOCCUS CAUSING ACUTE ULCERATIVE ENDOCARDITIS.

(PRELIMINARY REPORT.)

By W. G. MACCALLUM, M.D., AND T. W. HASTINGS, M.D.

(From the Pathological Laboratory of the Johns Hopkins University and Hospital.)

A. S., aged 37, was admitted to the service of Dr. Osler, September 14, 1898. Occupation and family history unimportant; personal history negative, excepting for an account of an indefinite febrile attack of three weeks' duration, in 1889, which was said to have been rheumatic fever.

Since July 4th, after contracting a severe cold, he had a fever which had been persistent until early in August, when it subsided but reappeared about the middle of the same month, and for this supposed relapse of typhoid fever the patient was sent to the hospital.

The signs of aortic valvular disease were noted on admission and the diagnosis of septicæmia and probable malignant endocarditis affecting the aortic valves was made after obtaining positive blood cultures on September 24th.

The growth from the blood cultures was thought to be a short-chained streptococcus often occurring in pairs, but subsequently, on study of that obtained upon different media, it proved to be a definite diplococcus. On October 1st, three days before death, blood cultures were taken a second time from the basilic vein with the same positive result.

The autopsy revealed an acute vegetative and ulcerative

aortic and mitral endocarditis. The aortic valves were bound together by exuberant branching vegetations which had undergone ulceration; several of the mitral chordæ tendinæ were ruptured and the broken ends covered with vegetations. In the spleen and kidney there were septic infarctions in various stages of softening, the fresher ones being firm and white, the oldest forming large thin-walled cavities with almost diffuent contents. One such embolic abscess was found in the ileum. There was also a bronchopneumonia of the left lung.

Sections of the aortic valves showed the fibrinous vegetations to be loaded with masses of diplococci, and in those passing through the infarcts in the kidney plugs of similar cocci were found in the vessels at the edges of the infarcted area. From the heart's blood and the aortic vegetations, as well as the infarcts in the spleen and kidney and from the lung, pure cultures were obtained of the diplococcus which presented, in brief, the following morphological and biological characters:

*Morphology.*—A small somewhat elongated diplococcus occurring sometimes in chains of four, but generally in pairs,

which stained easily by methods of Gram and Weigert. No demonstrable capsule.

*Agar* *Growth*.—showed minute semi-translucent pin-point deep colonies and corresponding minute discrete translucent round superficial colonies. On slant agar the smear gave rise to a thin translucent growth made up of conglomerated colonies, the edge of which is slightly raised and crenated.

Glucose and ascitic fluid agar afforded a more profuse and rather less translucent growth, while on glycerine agar the growth was comparatively scanty. There was no gas formation in glucose agar.

*Potato*.—The growth was slow to appear; after two or three days it showed as a dry whitish or tawny layer.

*Bouillon* was rendered very slightly opalescent after forty-eight hours.

*Litmus-milk* was decolorized within four hours. Later (within forty-eight hours) the milk was coagulated and acidified. After this there was a rapid peptonization of the coagulum, the medium becoming transformed first into a turbid purplish fluid, or a turbid yellow fluid, overlaid by a layer of red, and later into a quite clear blood-red fluid. This reaction is very characteristic and absolutely constant.

*Blood Serum*.—The growth appeared in minute discrete dew-like colonies. Within forty-eight hours there appeared a depression on the surface of the medium corresponding with the line of smear. Liquefaction of the medium occurred in course of time.

*Gelatin* was rather slowly but completely liquefied. Stab cultures took on the appearance of a wide funnel after about four days.

The sediment of organisms like the colonies on gelatin plates had a pale sulphur-yellow color.

The organism is quite hardy and may be recultivated from tubes several weeks old.

*Anaerobiosis*.—It is a facultative anaërobie, cultures in Buchner jars growing with about the same profusion and rapidity as the aerobic controls. In an atmosphere of hydrogen the growth is rather less abundant.

*Thermal Death Point*.—The diplococcus is killed in five minutes by a temperature ranging between 60° and 65° C.

*Pathogenicity*.—Laboratory animals succumb to inoculation. White mice do not survive the intraperitoneal injection of suspension of the cultures. Death may take place as early as eight hours or be delayed for three or four days. The micro-organism can be recovered from the blood and organs generally.

The subcutaneous inoculations of mice also produce fatal effects after a longer period—two to four days. In the latter positive experiments no lesion was found at the point of inoculation and the organism was not recovered from any source.

Rabbits appeared less susceptible. Of several experiments one rabbit which received 3 cc. of a suspension of the organism intravenously succumbed in 16 days. At the autopsy there was found an abscess at the site of inoculation, and from this as well as from the distended urinary bladder the organism was recovered.

One dog has thus far been inoculated after injury of the aortic valves by the passage of a probe into the heart through

the carotid (Rosenbach's operation), the culture being thrown into a vein. After five days the dog was killed and the autopsy revealed a fresh vegetative endocarditis, the vegetations springing from the edges of the perforation in the valve and from the point on the aortic wall where the intima was scraped off by the probe. There was also an extension of the vegetations onto the mitral valve; and at the point where the probe passed into the intraventricular septum an acute suppurative myocarditis had formed. The organism was recovered in pure culture from the aortic vegetations and from the heart's blood and organs generally.

Experiments with the ferments and toxins are in progress and will be reported later.

This diplococcus which has been proven to be pathogenic for man and some of the lower animals seems not to have been met with before—at least, there is no record of such an organism to be found in the bacteriological literature available to us. The chief peculiarities which distinguish it from the pyogenic cocci already described are:

(1) The mode of growth which resembles that of the micrococcus lanceolatus, the diplococcus intracellularis meningitidis and the streptococcus rather than that of the pyogenic staphylococci.

(2) The action on gelatin which resembles that of the staphylococci.

(3) Its activity in peptonizing milk and coagulated blood serum in which it differs from all the above-named pyogenic cocci.

In virtue of this last property and for the purpose of distinguishing it for the present, we propose the name *Micrococcus zymogenes*.

## ALFREDO ANTUNES KANTHACK.

Died at Cambridge, England, on the twenty-first of December, 1898, Alfredo Antunes Kanthack, M.A., M.D., F.R.C.P. (London), Fellow of King's College and Professor of Pathology in the University of Cambridge.

This announcement is a cruel blow to those who have had the good fortune to know and work with this brilliant man. Born in Brazil in 1863, the son of the former British consul at Para, Kanthack received much of his early education in Germany. Studying in England at the University College in Liverpool and at London University, he obtained his B. A. in 1884, his intermediate M. B. in 1885, and B. Sc. in 1886. Pursuing his studies at St. Bartholomew's Hospital, he received in 1887 the double qualification of M. R. C. S. and L. R. C. P. In 1888 he obtained the F. R. C. S. as well as the M. B. and B. S. (London), with honors, receiving also the gold medal for obstetrics. The year 1889 Kanthack spent in work under Virchow in the pathological laboratory at Berlin, but he was compelled in 1890 to leave, in the midst of some important investigations, to serve as obstetrical assistant in St. Bartholomew's Hospital under Dr. Matthews Duncan.

In the summer of 1890 he went to India as one of the commissioners appointed by the Royal College of Physicians, the



Royal College of Surgeons and the Executive Committee of the National Leprosy Fund to inquire into various points with regard to leprosy in India. A large share of the voluminous report of the commission was his work. Returning from India he became the John Lucas Walker student at Cambridge, but in 1892 he went to Liverpool with the intention of practising medicine. Here he held the post of medical tutor and demonstrator of bacteriology at the Royal Infirmary. Later, however, he went to London as director of the pathological laboratory, lecturer on pathology and bacteriology, and curator of the pathological museum at St. Bartholomew's Hospital. In 1896, during the illness of Professor Roy, he was appointed his deputy, and finally in the fall of 1897 he became professor of pathology at the University of Cambridge. In the same year he became an F. R. C. P., and was given the honorary degree of M. A. at Cambridge.

In his school days Kanthack had planned to devote his life to classical studies, and it was a disappointment to him at first to be compelled to turn to what he feared must be a more practical career; but from the beginning his energy and ability brought him enthusiasm and success. In the laboratory at Berlin he earned the admiration of all who knew him, and his early work in Virchow's Archiv on the pathology of the larynx\* gained for him the recognition of many others. By no one was he more appreciated than by his great "Master" as he reverently called him, whose attitude toward his pupil was one of genuine affection.

The feeling of his contemporaries cannot be better shown than by quoting in full the cordial letter of Prof. Langerhans, written at the time of his application for the professorship of pathology at Cambridge:

"Herr Dr. med. Alf. A. Kanthack, zur Zeit in Cambridge, hatte vom Sommer 1889 bis August 1890 im Berliner pathologischen Institut einen Arbeitsplatz in demjenigen Arbeitsaal inne, welcher für vorgeschrittene, selbstständige wissenschaftliche Arbeiter bestimmt ist und für welchen ich damals als zweiter Assistent von Rudolf Virchow meinem Chef gegenüber verantwortlich war. In dieser Eigenschaft bin ich damals täglich mit A. A. Kanthack zusammen thätig gewesen und bestätige ich hierdurch, dass sich Alf. A. Kanthack durch sein umfassendes Wissen, eiserne Energie, unermüden Fleiss, durch seine grosse Wahrheitsliebe und strenge Selbstkritik und durch seine feinen, liebenswürdigen und gewinnenden Umgangsformen die Achtung und Liebe aller, die mit ihm in Berührung kamen, gewonnen und dauernd erhalten hat."

Kanthack had published a considerable number of valuable scientific communications, a few of the more important of

which were, perhaps, the researches referred to concerning the larynx, his studies upon snake poison,\* his various communications with relation to leucocytosis, chemotaxis and immunity,† his studies on mycetoma,‡ his Jackson Prize Essay on the bacillus of tetanus, and his further contributions to the same subject with Dr. Connell,§ and his admirable article upon the general pathology of infection in the first volume of Clifford Allbutt's System of Medicine. He also published in 1894, in association with Dr. Rolleston, a "Manual of Practical Morbid Anatomy, being a handbook for the post-mortem room," and in 1895 with Dr. Drysdale, a "Course of Elementary Practical Bacteriology, including Bacteriological Analysis and Chemistry."

He superintended the observations upon the Tsetse fly disease for the Royal Society, and one of his last publications related to this subject.||

Much of his work, however, through his modesty and generosity, remained unknown. Only his more intimate friends are aware of the fact that he was the first to succeed in cultivating the parasite of actinomycosis. Compelled in January, 1890, to leave Berlin in the midst of his experiments, he made all possible arrangements for the preservation of his cultures, but on his return, they had, unfortunately, "died out" and another observer had anticipated him with the discovery.

A large share of his energy was given to the help and instruction of others who will bear the warmest testimony to the true worth of their friend and teacher.

His uncompromising honesty, his hatred of anything superficial or incomplete, combined with an active, keen, discriminating mind, and it seemed, an almost unlimited power for work, were a source of admiration to all who knew him. His amazing energy and capability for work were, however, too much even for a fine athletic physique, and his friends had for some years before his death looked with anxiety upon the amount of labor which he crowded into the day.

To the writer Kanthack always seemed the most brilliant of

\*The Nature of Cobra Poison. Journ. Physiol., Camb., 1892, xiii, 272-299. Report on Snake Venom in its Prophylactic Relations with Poisons of the Same and of Other Sorts. Rep. Med. Off. Local Gov., Bd. (1895-6), Lond., 1897, 235-266.

†Acute Leucocytosis Produced by Bacterial Products. Brit. Med. Journ., Lond., 1892, i, 1301-1303; Immunity, Phagocytosis and Chemotaxis. Brit. Med. Journ., Lond., 1892, ii, 985-989; (with Hardy) On the Characters and Behaviour of the Wandering (migrating) Cells of the Frog, especially in Relation to Microorganisms. Proc. Roy. Soc. Lond., 1892, lii, 267-273, and Phil. Tr., Lond., 1895, clxxxviii, 279-318; (with Westbrook) Report on Immunity Against Cholera: An experimental inquiry into the bearing on immunity of intracellular and metabolic bacterial products. Brit. Med. Journ., Lond., 1893, ii, 572-575; (with Hardy) The Morphology and Distribution of the Wandering Cells of Mammalia. Journ. Physiol., Camb., 1894, xvii, 81-119.

‡Madura Disease (mycetoma) and Actinomycosis. Journ. Path. and Bact., Edinb. and Lond., 1892, i, 140-162.

§The Flagella of the Tetanus Bacillus and Other Contributions to the Morphology of the Tetanus Bacillus. Journ. Path. and Bact., Edinb. and Lond., 1896-7, iv, 452, and Trans. Path. Soc. Lond., 1896-97, xlviii, 271-279.

||Kanthack, A. A., H. E. Durham and W. F. H. Blandford: On Nagana or Tsetse Fly Disease. Proc. Roy. Soc., Vol. 64.

\*Beiträge zu der Histologie der Stimmblätter mit specieller Berücksichtigung des Vorkommens von Drüsen und Papillen. Arch. f. path. Anat., etc., Berl., 1889, cxvii, 531-544; Studien über die Histologie der Larynxschleimhaut—I. Die Schleimhaut des halbausgetragenen Foetus. Ibid., 1889, cxviii, 137-147; Zur Histologie der Stimmblätter: Erwidlung auf den vorstehenden Artikel des Herrn Prof. B. Fraenkel. Ibid., 376-381; Studien über die Histologie der Larynxschleimhaut. Ibid., 1890, cxix, 326; cxx, 273.

his contemporaries. His ideals were the highest; and never was a man truer to his ideals. An exacting and searching critic of his friends, he was a severer critic of himself. This amounted sometimes to self-depreciation; it was indeed, on such occasions, almost pathetic to note the apparent unconsciousness of his own superiority.

And with his high ideals he was ever full of practical suggestion. He never tired of urging the necessity of a more general introduction of accurate and scientific methods into medicine. His last public address\* was an earnest appeal for more systematic and thorough clinical study in hospitals and schools.

His influence which was beginning to be generally felt in his own country was destined to have a far wider sphere. The loss of such a man is hardly greater to his university and to his friends than to the world at large.

Personally, Kanthack was the simplest and most lovable of men.

In 1895 he married Lucie, the daughter of F. Henstock, Esq., of Liverpool. W. S. T.

### NOTES ON NEW BOOKS.

**Operative Gynaecology.** By HOWARD A. KELLY, A. B., M. D.; Professor of Gynaecology and Obstetrics in Johns Hopkins University, Baltimore; Gynaecologist and Obstetrician to Johns Hopkins Hospital, Baltimore. 2 vols., 550 pages each, with 48 plates and 592 original illustrations. (*D. Appleton, New York, 1898.*)

This work is practically a series of clinical lectures, thoroughly and exquisitely illustrated by drawings from cases which have been under the author's care.

Volume No. I contains nineteen lectures upon the following topics:

1. Sepsis, asepsis, and antiseptics in hospitals.
  2. Antiseptics and asepsis in private practice.
  3. Bacteriology.
  4. Topographical anatomy.
  5. The gynaecological examination.
  6. Gynaecological instruments and dressings.
  7. Anaesthesia.
  8. General principles involved in plastic operations.
  9. Diseases of the external genitals.
  10. Rupture of the recto-vaginal septum and relaxed vaginal outlet.
  11. Operations on the vagina.
  12. Affections of the urethra and bladder.
  13. Affections of the ureters.
  14. Operations upon the cervix of the uterus, including dilatation and curettage.
  15. Prolapse of the uterus.
  16. Vaginal hysterectomy.
  17. Inversion of the uterus.
  18. Vaginal extirpation of the submucous myomata and polyp.
  19. The uterus as a retention cyst.
- The contents of Volume II are:
20. General principles and complications common to abdominal operations.

\* The Science and Art of Medicine. The Mid-session Address delivered before the Abernethian Society on July 7, 1898. *St. Bartholomew's Hospital Journal*, August, 1898.

21. Care of wound and patient up to recovery.
22. Complications arising after abdominal operations.
23. Tubercular peritonitis.
24. Suspension of the uterus.
25. Conservative operations on the tubes and ovaries.
26. Simple salpingo-oophorectomy and salpingo-oophorectomy for adherent tubes and ovaries.
27. Vaginal drainage and enucleation for pyosalpinx, ovarian abscess, tubo-ovarian abscess, and pelvic abscess.
28. Hysterectomy, with extirpation of ovaries and tubes, abdominal hyster-salpingo-oophorectomy.
29. Ovariectomy.
30. Abdominal hysterectomy for carcinoma and sarcoma of the uterus.
31. Myomectomy—hystero-myomectomy.
32. Operations during pregnancy.
33. Cesarean section.
34. Extra-uterine pregnancy.
35. The radical cure of hernia.
36. Intestinal complications.
37. The more remote results of abdominal operations.
38. On the conduct of autopsies, the making of protocols, and the preservation of tissues for microscopic examination in gynaecological practice.

Those who have been fortunate enough to see Dr. Kelly at home, will, while reading the work, easily imagine themselves in his operating room, listening to a brief history of the case to be operated upon; a review of the anatomy of the parts; a description of the operation to be done; the reasons for selecting this special procedure; the difficulties and dangers to be met, and the best way to overcome them. The style throughout is conversational, clear, concise, clean-cut, and impresses one with the feeling that the writer is presenting a frank statement of his experience in the treatment of the different diseased conditions met with in abdominal surgery.

Few books have been more eagerly looked for; few have so fully realized our expectations. The author in the opening paragraph of his preface says: "My aim in writing this book has been to place in the hands of many friends who have from time to time visited me, and followed my work, a convenient summary of the various gynaecological operations I have found best in my own practice. It is far from my purpose to present a digest of the literature of the subject, or even to describe all the important operations." The claims to originality are mainly connected with the operation for suspension of the uterus, the investigation of vesical and ureteral diseases, and with Kelly's modification of abdominal hysterectomy for fibroids. The chapters on sepsis and antiseptics, bacteriology, the conduct of autopsies, and preservation of tissues for microscopic examination, have been written with the assistance of acknowledged authorities in these several departments, and are deserving of more attention than is commonly given to chapters devoted to these subjects in surgical text-books.

However much we may desire to give special attention to individual chapters, the space at our disposal would preclude this, and we are compelled to speak of the work as a whole, and to present our impressions of it in a few sentences.

At first sight many will be inclined to think that the illustrations are the feature of the work, but those who have had any experience in abdominal surgery and its difficulties, and have read any considerable portion of the work carefully, will feel, that while the illustrations are all that illustrations could be, both from an artistic standpoint and because of their value in assisting the reader to follow the text, the great feature of the work is the careful selection of the best-known treatment for each disease described. Where, as in uterine fibroids, extra-uterine pregnancy, and pelvic abscess, the conditions in the different cases vary, the procedure best suited to those different conditions is indicated and clearly described. Wherever medical treatment is deemed of use, it is care-

fully outlined. The old-time "applications," however, find no place in the work. Where no mention is made of medical treatment it is because nothing can be hoped for from this quarter, and no course of treatment is encouraged which is likely to end in disappointment.

Another feature, and a pleasing one, is the spirit of conservatism which everywhere pervades the book. We find, for example, that par-ovarian cysts are now enucleated without sacrifice of the ovary, contrary to the former practice. In ovarian disease, where the tube is not involved, it is allowed to remain, and in uterine fibroids, when consistent with safety, myomectomy, and not hysterectomy is advised. While the work is of great value to all interested in abdominal surgery, representing, as it does, the most advanced thought of the day, it ought to receive special welcome from those practitioners who live at some distance from hospital centres. Such men, if they study the principles of aseptic abdominal surgery as enunciated in the early chapters of the work, will not only be enabled to retain under their own care cases now referred to the city specialist, but will also be able to extend treatment which in the past, has only been possible in the larger centres, to those who on account of their limited means cannot avail themselves of the services of a specialist.

Dr. Kelly's original work on suspension of the uterus and affections of the bladder and ureters, places the profession under permanent obligation to him. In originating the operation of suspension of the uterus he has added materially to our resources in the treatment of certain uterine displacements (decensus and retro-displacements). With this operation we have had some little experience, having done upwards of seventy cases with a single relapse, and without mortality. Two patients subsequently became pregnant and were delivered at term of living children, without special discomfort or complication; two others are advanced four months in pregnancy, without development of any abnormal position of the uterus. If we restrict the operation of ventral fixation to those suffering from displacement and who have passed the menopause, and employ suspension in such as are liable to become pregnant, the operation is likely to increase in favor, as a safe and reasonably certain method of securing relief from local discomforts, as well as from disorders referred to the stomach, spine and legs. Certainly in no class of cases have we met with greater gratitude, or seen more marked improvement in general health, than in those selected for this operation.

The easy use of the cystoscope and ureteral catheter requires a little experience and manipulative skill. To those who possess these requisites, Kelly's cystoscope and ureteral catheter will prove invaluable instruments, enabling them to recognize and relieve distressing conditions not generally diagnosed and therefore not corrected by the ordinary practitioner. Those who have mastered the use of these instruments, and this with a little perseverance is easily possible to all, will not long remain in doubt as to their value.

The work is an embodiment of modern ideas clearly and concisely presented in good order, and well represents the most advanced operative gynaecology of the day.

LESSLIE M. SWEETNAM.

#### BOOKS RECEIVED.

*Atlas of Legal Medicine.* By Dr. E. von Hofmann. Authorized translation from the German. Edited by F. Peterson, M. D., assisted by A. O. J. Kelley, M. D. 1898. 12mo. (Saunders' Medical Hand-Atlases.) W. B. Saunders, Philadelphia.

*Index Catalogue of the Library of the Surgeon-General's Office, United States Army.* Authors and Subjects. Second Series, Vol. III. C—Czygan. 1898. 4to. 1100 pages. Government Printing Office, Washington, D. C.

*A Pocket Medical Dictionary giving the Pronunciation and Definition of the Principal Words Used in Medicine and the Collateral Sciences, etc.* By George M. Gould, A. M., M. D. A new edition entirely rewritten and enlarged, including over 21,000 words. 1898. 16mo. 530 pages. P. Blakiston's Son & Co., Philadelphia.

*Twentieth Century Practice.* An International Encyclopedia of Modern Medical Science by Leading Authorities of Europe and America. Edited by Thomas L. Stedman, M. D. In Twenty Volumes. Vol. XVII. Infectious Diseases and Malignant New Growths. 1898. 8vo. 715 pages. Wm. Wood & Co., New York.

*Archives of Neurology and Psychopathology.* Vol. I., Nos. 1-2, 1898. 8vo. 262 pages. State Hospital Press, Utica, N. Y.

*Diseases of the Eye.* A Handbook of Ophthalmic Practice for Students and Practitioners. By G. E. de Schweinitz, A. M., M. D. Third Edition. 1899. 8vo. 696 pages. W. B. Saunders, Philadelphia.

*A Manual of Physiology.* With Practical Exercises. By G. N. Stewart, M. A., D. Sc., M. D., Edin., D. P. H., Camb. Third Edition. 1898. 8vo. 848 pages. W. B. Saunders, Philadelphia.

*A Text-Book of Mechano-Therapy.* (Massage and Medical Gymnastics.) Especially Prepared for the Use of Medical Students and Trained Nurses. By A. V. Grafstrom, B. Sc., M. D. 12mo. 1899. 139 pages. W. B. Saunders, Philadelphia.

*Saunders' Pocket Medical Formulary.* By Wm. M. Powell, M. D. Fifth Edition. 1899. 16mo. 290 pages. W. B. Saunders, Phila.

*The Treatment of Disease by Physical Methods.* By Thomas Stretch Dowse, M. D., Abd., F. R. C. P., Ed. 1898. 8vo. 412 pages. John Wright & Co., Bristol.

*A Text-Book of Obstetrics.* By Barton Cooke Hirst, M. D. 1898. 8vo. 846 pages. W. B. Saunders, Philadelphia.

*Purity and Truth. Self and Sex Series. What a Young Man Ought to Know.* 1897. 16mo. 281 pages. The Vir Publishing Co., Phila.

*Translation of Lectures Delivered by Aurelio Bianchi, M. D., Parma. On the Phonendoscope and its Practical Application.* With Translation of Special Articles by F. Regnault, M. D. and M. Anastasiades, M. D. Translated by A. G. Baker, A. M., M. D. 1898. 8vo. 77 pages. G. P. Pilling & Son, Philadelphia.

*Cleft Palate; Treatment of Simple Fractures by Operation; Diseases of Joints, etc.* By W. Arbuthnot Lane, M. S. 1897. 12mo. 278 pages. The Medical Publishing Co., Limited, London.

*Transactions of the American Gynecological Society.* Vol. XXIII. 1898. 8vo. 491 pages. Wm. J. Dornan, Philadelphia.

#### THE JOHNS HOPKINS HOSPITAL BULLETIN.

The Hospital Bulletin contains announcements of courses of lectures, programmes of clinical and pathological study, details of hospital and dispensary practice, abstracts of papers read and other proceedings of the Medical Society of the Hospital, reports of lectures, and other matters of general interest in connection with the work of the Hospital. It is issued monthly.

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### AN ANALYSIS OF THE CASES OF TABES IN THE JOHNS HOPKINS HOSPITAL AND DISPENSARY FROM ITS OPENING IN MAY, 1889, TO DECEMBER 1, 1898.

By H. M. THOMAS, M. D., *Clinical Professor of Nervous Diseases, Johns Hopkins University, Neurologist to the Johns Hopkins Hospital.*

In the records of the Dispensary of the Johns Hopkins Hospital there are one hundred histories which have been classed as tabes. Of these I have excluded eight histories, either because the records are too incomplete, or because the diagnosis seems to have been a mistaken one. Twenty-seven cases have been treated in the wards of the Hospital, but unfortunately for the purposes of this paper, many of them were private patients in whose histories the records are often not complete.

Eight (8) of the patients were treated both in the wards of the Hospital and in the dispensary, and we therefore have for comparison the histories of 111 cases of tabes. That these histories are not all equally good, need not be said, and, indeed, not a few of them leave much to be desired.\*

\*After having read through some 130 histories, I feel that I might with propriety make some observations upon the taking of histories, which, if followed, would be useful at least to the one who has to tabulate them, but I shall not, only saying as I pass, that it is a subject which deserves more attention than is often given to it.

RACE.—White, 106; negroes, 5. Of the 106 white patients 70 were born in this country, 17 were Germans, 6 were Irish, and England, Scotland and France were each represented by 2; 6 patients were simply registered as white.

The small number of negroes is of particular interest, and deserves more detailed attention. We have, as I have just said, seen but five colored patients, in whom the diagnosis of tabes seemed in the least justifiable; that is to say, but 4.5 per cent. of our cases of tabes have any discoverable African blood in their veins, for it is to be remembered that in the eye of the law and of the statistician it takes but very little African blood to make a negro.

In the two years ending November 1, 1898, there were registered in the dispensary 35,796 new cases. Of these 3598 were negroes. This makes the negroes represent a little more than 10 per cent. (10.05 per cent.) of the new cases treated. In the cases of tabes, however, our percentage of negroes is only 4.5, which is less than half what it should be if the negroes were represented in their proper proportion. This difference, although interesting in itself, is hardly great enough to warrant

much attention were it not for other considerations. I think I shall not be accused of exaggeration when I state that the great majority of physicians who are qualified to judge have come to the belief that syphilis is the chief, if not the only, cause of tabes.

We in the South know that syphilis is a very common disease among the negroes, but upon examining the records of the dispensary, I was surprised to discover how common it is. In the two years selected for comparison there were treated in the Genito-Urinary and Skin Departments 238 men who were suffering either from the primary syphilitic sore or the secondary skin eruptions. Sixty-three of these men were negroes, that is 27.63 per cent. of the whole number. When we compare this percentage with that which the negro men represent in the whole number of the men registered in the dispensary, during these years, is quite startling. There were registered 17,888 white males and 1223 colored males, *i. e.* 6.39 per cent. of colored males. Unfortunately there are included in this males of all ages, and so the comparison is not perfectly fair; but I believe the error is not great. We have then, during these two years, the negro males, representing 6.39 per cent. of all the males treated in the dispensary, but of the cases of syphilis seen in men during this time, the negroes make up 27.63 per cent.

If we determine the percentage which the cases of syphilis in white and black men, treated in the Skin and Genito-Urinary Departments during two years, bears to the whole number of males of each color admitted to the dispensary during that time, we find it is for the whites 0.91 per cent. while for the negroes it is 5.15 per cent. From this it would seem that in the men coming to this dispensary, the percentage of early syphilis is more than five and a half times greater in the negro race than it is in the white.

**SEX.**—Men, 92 white, 5 colored—97; women, 14 white—14. That is, the women represented about 12.6 per cent. of the whole number. In the dispensary the percentage of women suffering from tabes is smaller, being a little more than 9 per cent. (9.17 per cent.), whereas female patients represent a little more than 46 per cent. of all patients in the dispensary. In the cases of tabes treated in the wards of the Hospital, the percentage of women is distinctly larger than in the dispensary, reaching 25 per cent.

It is interesting to note that in the first 50 cases treated in the dispensary there was but one woman, and that she was the 50th case. On the other hand, in the wards, 3 out of the first 5 cases were women. This shows how very unreliable such statistics are unless a very large number of cases is considered.

Five of the patients were seen in the private wards of the Hospital and were from the higher strata of society. This is contrary to the usual statement that tabes affects women of the lower classes far more frequently than those who are more fortunately situated. Moebius, out of 40 cases, found only one belonging to the upper classes.

This relative immunity that women appear to enjoy from tabes cannot be due altogether, I believe, to the fact that fewer women suffer from syphilis than men. That syphilis is more common among men seems to be universally believed, and I have no doubt is true as a general proposition.

In certain classes of society, however, the difference, if it exists at all, cannot be great. As an illustration of this, the records of the Skin Department are instructive. During the two years preceding November, 1898, 130 men and 121 women were treated for the skin manifestations of syphilis, but during this time, more men were admitted to the dispensary in general, as well as to the skin clinics, so that if these figures indicated anything as to the liability of syphilis, it would seem that women are slightly more liable to the disease than men. We have as yet seen no case of tabes in a negro woman,\* whereas syphilis is most common in them; 42 of the 121 cases of skin syphilis in women were negroes, *i. e.* 34.87 per cent. The percentage of black females to the whole number of females in the dispensary is 14.23 per cent.

AGE OF ONSET.	No.
25-29	8
30-34	17
35-39	24
40-44	27
45-50	16
50 and over.	15
Total, 107	

The time of onset of the disease showed nothing of very great interest. Most of the cases developed between 30 and 50. The youngest case was 25, and the oldest 66. The series includes 15 cases which developed after 50, and this is a larger number than would be expected. It may be doubted whether these senile cases should be included, but I do not see how we can do otherwise when the patients present the symptoms and signs that would have led to the diagnosis of tabes had they occurred at an earlier age.†

The onset of tabes is often very insidious and the early stages may last for many years and it seems probable that some of these patients may have been unconscious or may have forgotten the first symptoms.

**DURATION OF THE DISEASE AT THE TIME OF EXAMINATION.**—Cases, 104. This could be determined with more or less accuracy in 104 cases. Duration 1 year or less, 18 cases; between 1 and three years, 34 cases; between 3 and 5 years,

\* Since this analysis was made we have examined a colored woman in the Neurological Dispensary (No. 9525) who is suffering from symptoms that indicate tabes; irregular pains, numbness of the feet, difficulty in walking, loss of knee kicks, objective sensory disturbances on legs. The pupils were normal, and no history of syphilis could be obtained.

† Neurol. No. 2947. A man 70 years old, who gave the history of having had a venereal sore at 25, which was followed by a doubtful secondary skin eruption, came to the dispensary complaining that for the last 4 years he had had difficulty in walking in the dark. He had also had slight shooting pains and his feet felt numb. His pupils were of normal size. They reacted very slightly to light, the left better than the right. Both pupils reacted well during accommodation. His knee jerks were absent, his walk was stamping, the heel being brought down first, and he was unable to stand firmly with eyes closed. There was considerable anesthesia of his legs.

17 cases; between 5 and 10 years, 24 cases; between 10 and 20 years, 10 cases; 30 years, 1 case.

Most of the cases (69) were seen during the first 5 years of the disease, but in 11 cases it had lasted 10 years or more, once even reaching 30 years.

**ETIOLOGY.**—Believing as we do that syphilis is the cause of the vast majority of cases of *tabes*, we have practically confined our attention to this factor.

Only men have been considered in the following table, and there are definite notes in 95 of the 97 cases.

Exposure to venereal contagion denied...	3		
Exposure admitted but infection denied...	7		
Infection denied (exposure?) .....	7		
Venereal infection denied.....	17	17.89 per cent.	
Gonorrhœa alone.....	18		
Venereal sore denied.....	35	36.84	"
Gonorrhœa with chancre— <i>indefinite</i> .....	15		
Gonorrhœa with syphilis .....	20		
Gonorrhœa* .....	53	55.78	"
Chancre, syphilis.....	38		
Syphilis with no history of chancre.....	2		
Certain syphilis.....	40	42.1	"
Chancre <i>indefinite</i> .....	20		
Possible syphilis.....	60	63.1	"

By certain syphilis is meant the definite history of a chancre which was believed to be syphilitic and was treated as such, or the history of a chancre which was followed by secondary manifestations, and in two instances, where skin eruptions were recognized as syphilitic, although there was no history of the primary sore. All other venereal sores have been tabulated as *indefinite* chancres.

In taking the histories, the supposition has been that in all cases of *tabes* syphilis has preceded, and the burden of proof has been with the patient who denied its presence.

The results are: Certain syphilis, 42.1 per cent.; possible or probable syphilis, 63.1 per cent. These figures fall below those obtained by many of the later observers, but it is not due to lack of zeal.

Some time ago I analyzed the sexual histories of 1238 men who came to the Neurological Dispensary suffering from all sorts of troubles; in them I found certain syphilis in 10.9 per cent., and possible or probable syphilis in 21.4 per cent.

These percentages are much smaller than those found in *tabes* and the inference that syphilis bears an important relation to the development of *tabes* is plain, but I must resist the temptation of entering fully into the discussion of syphilis as the cause of *tabes*. It may not be, however, out of order to sum up what the cases studied here seem to show:

1. In a large proportion of cases of *tabes*, a history of syphilis can be obtained.

2. In a certain and not inconsiderable number of cases there is no history of a venereal sore or other syphilitic manifestations.

3. In negroes, *tabes* is relatively uncommon, whereas syphilis is much more common in them than in the white population.

\* Note.—In some of the early cases the history in regard to gonorrhœa was not particularly noted and for this reason the number given is probably too small.

4. The partial immunity of women is greater than can be satisfactorily accounted for by the relative infrequency of syphilis among them.

I do not take these conclusions as indicating that syphilis is not the most important cause of *tabes*; on the contrary, they seem to me to speak in favor of this belief. The fact that we were unable to elicit the history of syphilis in 36 per cent. of our cases does not of course prove that syphilis was not present in a large proportion of these cases.

Although *tabes* does not seem to be common in the negro, when it does occur, it has usually been preceded by syphilis. In four of our five cases there was the history of a venereal sore, and the same has been shown in the cases of *tabes* in women.\*

That syphilis is not the only factor in this causation of *tabes* does seem to be shown. What the factors are that make white men so much more liable than black women to the development of *tabes*, I am sure I do not know; but of this I feel reasonably certain—that it is not due simply to the difference of primary syphilis among them. To say that it is due to a racial and sexual difference in the power of resistance of the nervous system, does little more than restate the facts.

Virchow† has lately raised his voice against the methods of study which have led to the all but universal belief that *tabes* is always directly dependent upon preceding syphilis.

The time between the syphilitic infection and the first symptoms of *tabes* varies a good deal. This point was determined in 47 cases.

*Tabes* developed after the venereal sore in 47 cases. In the first 5 years, 6 times; in the second 5 years, 10 times; in the third 5 years, 13 times; in the fourth 5 years, 10 times; in the fifth 5 years, 4 times; after 25 years, 4 times.

The shortest interval was 2 years, and the longest intervals were 26, 27, 30 and 42. It occurred about equally in the second, third and fourth five years.

As to the other causes of *tabes*, our histories show nothing important.

**INITIAL SYMPTOMS.**—Either alone or associated, the following symptoms occurred as initial symptoms: Pain, 57 times; ataxia, 24 times; numbness, extremities, 6 times; eye symptoms, 20 times; nausea and vomiting (gastric crises), 4 times; paralysis of bladder, 5 times; loss of sexual power, 1 time; paralytic attacks, 2 times; mental symptoms, 1 time; neurasthenia, 1 time.

*Pain*.—Pain was the first symptom in the majority of cases, occurring first or very early in the disease 57 times. It was unassociated 41 times and accompanied by other symptoms 16 times.

*Ataxia*.—Difficulty in walking and ataxia were the first symptoms 15 times, and were associated with other symptoms 9 other times.

*Eye symptoms*.—Double vision was the initial symptom 6 times. Dimness of vision occurred first alone 4 times. Double vision and dimness of vision were associated once, and double

\* Kron. Dent. Zeitschr. f. Nervenheilk., XII—1898, p. 303. "Ueber *tabes dorsalis* beim Weiblichen Geschlecht."

† Centralt. f. Nervenheilkunde in Psychiat., Nr. 105, 1898, p. 625.



vision with other symptoms 7 times. Ptosis was the first symptom, associated with pain twice.

*Numbness of extremities* occurred alone 4 times, with pain twice.

*Paralysis of the bladder* occurred alone 4 times, with pain twice.

**SUBJECTIVE SENSORY SYMPTOMS—Pain.**—In 71 cases pain was a prominent symptom. This was usually described as the characteristic lightning or shooting pain. In most cases it was severe, but in some it was mild. The pains were usually localized in the legs, but in three cases they were confined to the body, and in two to the arms, and in six others they were more or less general.

*Girdle sense or pain*, 27.—This symptom was noted as being present in 27 cases. Sense of numbness in the extremities, 45.

Numbness of the feet was complained of 30 times, the patients often describing a feeling as if the floor were not solid or as if they were walking on some soft substance. There was numbness in both the hands and feet 12 times, and in the hands alone 3 times.

*Crisis.*—Gastric crises, 9. There were nine patients who gave the history of having had gastric crises. In two of the cases the nausea and vomiting were unaccompanied by pain. In one of the cases very typical gastric crisis and Argyll-Robertson pupils were the only symptoms of tabes.

*Laryngeal crises*, 2. Two of our cases were subject to spasmodic cough; one of them was a typical case of tabes, but in the other the diagnosis was doubtful.

*Rectal crisis*, 1. One patient complained that early in his disease he had been subject to intense pain that began in the penis and ran to the rectum.\*

*Eye symptoms—Optic atrophy*, 11.—Optic atrophy occurred in 11, possibly 12 cases. The twelfth case was one in which one optic nerve looked as if atrophy had begun. In the other cases it was double.

*Eye muscle paralysis*, 33.—Transient double vision was noted as having occurred in 20 cases, and in 13 other cases there was a noticeable weakness of one or more of the external muscles of the eyeballs. In one of these cases there was complete external ophthalmoplegia.

Ptosis was present in 7 cases, and in 1 there was nystagmus.

*Pupils—Size.*—The pupils were unequal in 30 cases. The left was larger than the right 18 times while the right was the larger 8 times. In four instances the history did not specify which was the larger.

There was contraction of the pupils in ten cases and they were noted as dilated twice.

*Pupillary reflexes.*—Argyll-Robertson pupils, 70. Both pupils immovable to light, reacted well during accommodation, 59. In one eye, 3. Reacted slightly to light, well to accommodation, 8.

The pupillary reflexes were said to be absent 8 times, and weak 3 times. They were found to be normal 21 times.

*Ataxia.*—Ataxia was present 91 times: in the legs alone, 78

times; in the arms alone, 2 times; in both arms and legs, 11 times. There was no ataxia 8 times.\*

*Romberg's symptom*, 82.—Present 82 times, marked 59 times, slight 23 times, absent 7 times, not noted 22 times.

*Ataxia with optic nerve atrophy.*—In the cases which showed atrophy of the optic nerve, ataxia was marked in 2 cases. It was slight in 8 cases and was absent in 1. In two of the cases Romberg's symptom was marked in spite of the patients being blind. It was very slightly marked in 4 cases, and was absent in 4 and not noted in 1.

*Deep reflexes.*—The knee jerks were absent 87 times; weak 6 times; normal 4 times; not noted 14 times.

*Bladder.*—The condition of the bladder was noted in 83 cases: Weakness, 35 times; paralyzed, 19 times; normal, 29 times.

*Sexual power.*—The sexual power was inquired into in 75 cases: Power and desire lost, 38 cases (marked increase before the loss in 3 cases); power and desire weakened, 24 cases; power lost, desire retained, 1; power and desire increased 1; normal, 10; sexual power present, intercourse without sensation, 1 case.

*Objective sensory disturbances.*—There are definite notes in this respect in 90 cases: Objective sensory disturbances were present in 78 cases; absent in 12 cases.

These were more often in the legs (40 times), but were also demonstrated in the arms and about the chest.

Definite areas of anæsthesia were marked out about the chest in several cases, but this was looked for and not found in more cases. The number of examinations, however, was not sufficient to make the definite proportions of any great value.

*Muscular sense.*—There were definite notes in 44 cases. In these it was disturbed 38 times, normal 6 times.

*Trophic disturbances.*—Charcot's joints (Arthropathies).—These occur in a typical manner in 5 cases. There was suspicious enlargement of the joint in 3 cases.† In the 5 cases it occurred 3 times in the knee joints, 1 in the shoulder, and 1 in the elbow.

*Perforating ulcer.*—This occurred 5 times.

**MENTAL SYMPTOMS.**—There were mental symptoms present in seven cases, and in one case there was a history of a previous attack of acute insanity, and in one epilepsy had been present from the 14th year up to the time of the onset of tabes, at 44. Since then there had been no fits.

In the 7 cases showing mental symptoms general paresis was suggested. In two of the cases this disease developed while the patients were under observation.

\* In eight (8) of the cases the ataxia developed quickly. At times this followed an accident, but at other times there was no cause that could be determined. In most, if not all, of the cases, symptoms of tabes had been present for some time before the acute development of the ataxia.

† In one of these patients, who, since this was written, has returned to the dispensary after an absence of two years, and who had, at the time of his first examination, in 1897, a suspicious swelling of the last phalangeal joint of the left index finger, there has developed an undoubted tabetic arthropathy of the right thumb. This patient also had a healed perforating ulcer.

\* Since this list was completed I have seen another case of tabes that complained of the same symptom.

## ON TYPHOID SEPTICÆMIA, WITH THE REPORT OF TWO CASES, ONE OF WHICH WAS A TYPHOID INFECTION WITHOUT INTESTINAL LESIONS.

BY AUGUST JEROME LARTIGAU, M. D., *Assistant in Pathology and Bacteriology, Bender Hygienic Laboratory, Albany, New York.*

Our knowledge of the various forms of typhoid infections has rapidly increased within the past few years, and more particularly that regarding the character of those atypical and more rare forms, the chief interest of which lies in the singularity of localization of the typhoid bacillus. The value of the contributions of recent years is largely the outcome of improved bacteriological technique and closer and more accurate study of the natural history, cultural behavior and experimental manifestations of the bacillus typhosus and the bacillus coli communis. Investigators have appreciated more and more the necessity of exact methods of differentiation between bacterial forms, and especially between more or less closely allied species, such as the bacillus of typhoid fever and the colon bacillus.

The absence of precise methods of differentiation between these two micro-organisms by the earlier workers in this field has, of necessity, thrown much discredit upon the conclusions and results of otherwise much good and brilliant work. The belief of the passage into, and existence of, the typhoid bacillus in the blood of the general circulation is by no means a new one, as shown by the writings of some of the early writers who worked upon typhoid fever. Rüttemeyer, Almquist, Meisels, Neuhaus, and others, claimed to have cultivated the bacillus from the general blood and that of the rose-spots during life, but their work, through the latter researches of Janowski, Stagnitta, Grawitz, Fraenkel and Simmonds, and Sittman has not received acceptance. According to some observers the typhoid bacillus in almost every case at some time of the disease escapes into the general circulation from the more common foci of infection.

This view has received some support from the investigations of late years, demonstrating the great multiplicity of localization of Eberth's bacillus in the human economy: lesions of the bones, pulmonary implications, uterine infection, abscesses of various nature, etc., in all of which the organism has been found in pure culture. Wright and Semple<sup>1</sup> and Sanarelli<sup>2</sup> and other observers regard typhoid fever as primarily a blood infection, the two former writers basing their contention largely upon the fact that in the urine of almost every case suffering from typhoid fever they were able to find the specific organism. Recent researches, however, show more and more conclusively that the typhoid bacillus is not, commonly, to be found in the blood of the general circulation. The explanation of this apparent discrepancy between the results of Sanarelli, and Wright and Semple and other observers, who from their investigations have shown that the bacillus is only infrequently found in the general circulation, is to be found probably in the suggestive experiments of Wyssokowitsch<sup>3</sup> and the observations of Welch and Nuttall<sup>4</sup>. The first experimenter in some very interesting experiments upon rabbits was able to show that the organs in which typhoid bacilli are commonly found play a very important rôle in the removal of introduced bacteria from the blood. After injecting pure cultures of the typhoid bacillus into the blood the animals were sacrificed at

the end of eighteen hours, and bacteriological examination invariably failed to show bacilli in the blood of the general circulation, but always showed them in great numbers in the spleen. Welch and Nuttall in 1891, on the other hand, demonstrated the bactericidal properties of human blood serum for the typhoid bacillus, an observation since confirmed by a host of investigators.

Instances of typhoid septicæmia diagnosed during life by isolating the bacilli from the blood are very scanty in number. Bozzolo,<sup>5</sup> Guarnieri,<sup>6</sup> and Silvestrini<sup>7</sup> have reported cases of this nature; Wiltsehour<sup>8</sup> in the examinations of 35 cases found it once; Ettlinger<sup>9</sup> similarly succeeded in cultivating it from the blood during life, but a second culture in the same case from the vein of the forearm, the day before the patient's death, gave a doubtful result. Thiemich<sup>10</sup> found it once in the blood taken during life from a vein of the forearm, and Stern<sup>11</sup> was likewise successful in two instances. P. Teissier<sup>12</sup> isolated the typhoid bacillus from the blood of a young man in the 15th day of his disease; Kühnau<sup>13</sup> grew the organism from the blood of a pregnant woman during life in which the subsequent post-mortem findings confirmed the existence of a typhoid septicæmia; more recently this writer<sup>14</sup> has published the reports of nine additional instances in which he found typhoid bacilli in the blood out of 41 cases of typhoid fever submitted to bacteriological examinations. E. Bates Block<sup>15</sup> has reported a very conclusive example of this kind in which the typhoid bacillus was discovered in the blood during life on two different occasions, at an interval of four days. This case presents several interesting features, among others being the fact that a culture taken on the day before the patient's death contained the bacillus typhosus, whilst the bacteriological examination, post mortem, demonstrated its presence only in the spleen, liver, placenta, and kidneys, and the bacillus pyocyaneus in the heart's blood. In the recent Medical and Surgical Reports of the Presbyterian Hospital,<sup>16</sup> Walter R. James and George A. Tuttle report three cases in which they succeeded in isolating the bacilli from the blood during life.

The diagnosis on the autopsy table of general invasion by the bacillus typhosus is far less rare than its recognition during life, but it must not be supposed that as a post-mortem finding it is a frequent occurrence. The very early reports of this kind will not be considered in this paper, since their study was carried on at a time when the differences between the typhoid bacillus and the colon group were less appreciated than now. Karlinski,<sup>17</sup> Vincent,<sup>18</sup> Klein,<sup>19</sup> Banti,<sup>20</sup> Wright and Stokes,<sup>21</sup> Flexner,<sup>22</sup> Carter,<sup>23</sup> Chiari and Kraus,<sup>24</sup> and finally Blumer<sup>25</sup> have contributed a fair number of instances in adults that showed the organism in the blood after death. Typhoid septicæmia is an occurrence of comparatively greater frequency in the fetus born of a mother suffering from typhoid infection. The passage of the organism from mother to fetus has repeatedly received demonstration in the observations of



Frasconi<sup>26</sup>, Janiszewski<sup>27</sup>, Freund and Levy<sup>28</sup>, Dürck<sup>29</sup>, Etienne<sup>30</sup>, Marfan<sup>31</sup> and probably earlier observers.

The question of the bacterial associations in this class of infections is an exceedingly interesting one, and especially the influence of secondary infections in modifying the relation of the patient to the typhoid bacillus. Vincent<sup>32</sup> in 1891 called attention to the importance of the streptococcus in typhoid infections. This observer found in cases of typhoid fever brought to autopsy the streptococcus and typhoid bacillus associated in six out of thirty-one cases. The investigations of Flexner<sup>33</sup> similarly demonstrated the frequency with which the streptococcus is found as a complicating factor in this disease; other observations of the same nature were made by Wright and Stokes<sup>34</sup>, Netter<sup>35</sup>, E. Fraenkel<sup>36</sup>, Karlinski<sup>37</sup>, Carter<sup>38</sup>, and others.

The recently published case by Blumer<sup>39</sup> deserves special mention, not only as an instance of typhoid and streptococcus septicæmia, but also as a rare example of combined typhoid and streptococcus puerperal infection. The case was that of a married woman, 34 years of age, who was confined by a midwife. On the sixth day of the puerperium the patient, shortly after a hearty meal, was taken with dyspnoea and incoherency of speech. She rapidly became delirious and semi-comatose. The temperature was 100.8 F. The uterus was apparently normal. Patient died two days after the onset of her trouble. The post-mortem examination showed the existence of typhoid fever: swelling and ulceration of Peyer's patches in the lower end of the ileum, acute spleen tumor and enlargement of mesenteric glands. The cultures from the heart's blood, liver, spleen, and uterine cavity, contained the streptococcus pyogenes and the bacillus of typhoid fever.

For the abstracts from the histories of the two following cases I am indebted to Drs. Henry Hun and Joseph D. Craig, of Albany, New York:

CASE I.—Miss A., 20 years of age, came under observation October 13, 1897, complaining of gastric disturbances and fever.

The past history is unimportant, except that three years before she had an attack of gripe, which was accompanied by very irregular and alarming heart action. On the 16th day of October, 1897, the patient was taken ill with nausea, and was actively sick at her stomach. The following day she still felt ill and a physician, who was called in, found a temperature of 102° F., together with a very decided degree of prostration. The patient brought under observation at this time did not show any tenderness or gurgling in the right iliac fossa and there had been no diarrhoea. From this time there was fever varying from 102° F. to 106.6° F.—the temperature at the time of her death. The spleen and liver became enlarged, later delirium supervened, vomiting persisted and cardiac weakness became prominent; no diarrhoea at any time. Patient died October 25, 1897.

The autopsy was made on October 26th, 15½ hours after death.

The following notes are abstracted from the autopsy protocol:

*Exterior.*—Body of a slender-built, moderately well-nourished girl. Rigor mortis well marked all over. Post-mortem lividity in the dependent parts. Pupils mid wide and equal. Mucous membranes slightly cyanotic. Surfaces of body gen-

erally pale, subcutaneous fat moderate in amount. Abdominal muscles of a homogeneous red-brown color. Peritoneal cavity dry, parietal layer smooth; visceral layer shows numerous areas over which there is congestion apparently corresponding to Peyer's patches. Omentum delicate, free from adhesions, completely covering the intestines. Appendix about 9 cm. long, has a distinct mesentery to within 1 cm. of its tip; passes downward and inward across pelvic brim. The liver is visible two fingers' breadth below the costal margin in the mammary line. Spleen not visible. Both pleural cavities were dry; both lungs presented about the same appearance; the upper lobes were slightly congested; the lower and middle lobes on the right side and the lower lobe on the left were much congested, and on pressure a large quantity of dark blood could be expressed. A small quantity of mucus could be expressed from the medium-sized bronchi. Bronchial mucous membrane irregularly congested.

*Heart.*—Pericardium contains no excess of fluid. Pericardium is smooth. There are a few pin-point sub-pericardial hemorrhages. Heart contains fluid blood. The endocardium on the right side is smooth, the muscle shining through it has a somewhat mottled appearance in places. The tricuspid and pulmonary semilunar valves are normal. The length of the right ventricle is 6 cm.; the average thickness of the wall 4 mm. The pulmonary artery has a circumference of 5 cm. The endocardium of the left side of the heart is, in places, slightly thickened over the auricle. The ventricle is normal. Aortic and mitral valves are normal. Heart muscle is rather flabby and on section has a very cloudy, grayish-brown color, in places somewhat mottled in appearance. In both coronary arteries, which are patent, are small elevated areas of fatty atheroma. Spleen is much enlarged, measuring 17 x 20 x 5 cm. The capsule is smooth, tense; consistency of organ much softer than normal. On section the organ is of a chocolate-red color. The pulp is considerably increased in amount. The Malpighian bodies are plainly visible as pin-point, gray, circular areas. Liver is considerably increased in size, measures 23x19x6½ cm. There seem to be a number of pinhead-sized hemorrhages beneath the capsule; consistency much softer than normal. On section the organ has the typical boiled appearance; the lobules are indistinct, the peripheries being quite yellow where they can be made out. Scattered throughout the organ is a number of pinhead-sized blood-red areas, apparently hemorrhages.

The adrenal glands appear normal.

Kidneys of about the same size, averaging 13 x 4½ x 3 cm. fibrous capsule normal and strips off easily; surface smooth; surface veins little dilated. On section cortex is swollen; cortex markings are somewhat indistinct; the glomeruli barely visible; the medulla congested. Pelvis appears normal.

Stomach and pancreas and female generative organs not examined.

*Intestines.*—Duodenum slightly bile-stained. Mucous membrane slightly congested; jejunum shows similar changes, but with apparently no ulcerations. In the ileum, beginning 80 cm. above the ilio-cæcal valve, are a series of lesions affecting the solitary follicles and Peyer's patches. They are least marked in the upper portion of the ileum, where they consist in a great swelling of the lymphatic apparatus. The solitary follicles



measure as much as one-half cm. in diameter. The most recent swollen patches are considerably elevated above the surface. They have a mottled appearance, the predominating color being pink, and the mottling being due to yellowish areas, presumably of necrosis, as in one or two places the surface has been broken and ulcers formed. In the lower portion of the ileum the swelling is much more extensive and the necrosis much more marked. The solitary follicles are often the size of a large pea, their inner surface being capped with an ulcerated area on which a yellow necrotic material is situated. The swollen Peyer's patches in the lower portion of the ileum show, scattered over their surface, numerous ulcerated areas, capped with this same yellowish necrotic material, varying in diameter from 4 mm. to considerably over a cm. The edges of all these ulcerated areas are, in places, distinctly hemorrhagic and, as a rule, the blood-vessels of the intestinal wall can be seen radiating from the edges of the lymphatic apparatus, filled with blood. The lymphatic apparatus of appendix is markedly swollen, but no ulcerations are present. The upper portion of the colon is thickly dotted with swollen solitary follicles. These have an average diameter of about 7 mm., are considerably raised above the surface of the intestine, and show on their inner surface ulcerated areas capped by yellowish necrotic material similar to those seen in the small intestine. They differ from these latter from the fact that their bases are, as a rule, distinctly hemorrhagic, each nodule being surrounded by a distinct zone of submucous hemorrhage. The lower part of the colon is almost entirely free from such areas, but contains a number of discrete or confluent pin-head areas of hemorrhages.

*Mesenteric Glands.*—Particularly those behind lower portion of ileum are extremely swollen. They are soft in consistency and on section have a mottled appearance, the predominating color being a bright pink, the mottling being due to pin-point gray areas, which are scattered through them, perhaps the swollen follicular portions of the glands.

*Anatomical Diagnosis.*—Typhoid fever (beginning of second week), with typhoid septicæmia. Swelling of Peyer's patches and the solitary follicles with superficial necrosis and ulceration. Marked involvement of the solitary follicles in the upper portion of the colon. Great swelling of the mesenteric glands. Acute spleen tumor. Cloudy swelling of the heart muscle, liver and kidneys.

The microscopic examination of the heart, lungs, and kidneys adds particularly nothing to the macroscopic observations, except that the heart muscle showed the evidences of a moderate degree of fragmentation myocardii. The following are the notes from the protocol regarding the microscopic appearances of the liver, spleen, mesenteric glands, and intestines:

*Liver.*—Capsule is everywhere normal in appearance. The connective tissue is not increased in amount. Liver cells are greatly swollen and extremely granular. Scattered throughout the liver substance are numerous, almost circular areas, presenting varying appearances, according to the stage of development. In some instances the areas show merely an extensive necrosis of the liver cells, many of them in such areas having lost their nuclei, this loss of nuclei giving rise to a light colored patch in the liver substance. Many of the other areas show, besides this necrosis, an infiltration with

cells of varying characters. In some of them the necrotic area is infiltrated, for the most part, with small round cells of the lymphoid type. In others, large numbers of irregularly shaped epithelioid cells are present. No giant cells can be made out. The nodules resemble very markedly, in some instances, miliary tubercles, but there is not present a definite arrangement of the two varieties of cell, such as exists in tubercle; but, on the other hand, the two forms are evenly intermingled in the nodules. These nodules apparently bear no definite relation to any particular anatomical structure of the liver in most instances, although at least in one instance the necrotic area lies exactly around the central vein of the lobule. Besides areas of necrosis, there are found scattered through the organ a number of blue-staining areas, usually of much less extent than those occupied by the nodules. These areas have a granular appearance under the low power and which is more marked under the high power. It can be seen, at the edges particularly, that they are made up of individual rod-like structures resembling the typhoid bacilli. The blood-vessels of the liver show no particular change; nor do the bile-vessels.

*Spleen.*—Capsule not thickened. Trabecular substance is normal in amount. The amount of blood present in the pulp is tremendously increased over the normal. Furthermore, it can be made out with the high power that in a great many instances the red-blood corpuscles are contained in large cells. Scattered throughout the organ are a number of almost circular areas, in which it can be seen with the high power that considerable necrosis exists, as is shown by lack of nuclei and many of the spleen cells, and by the presence of nuclear fragments. These areas, as in the liver, are often infiltrated with lymphoid and epithelioid cells. There are also present in the spleen numerous blue-staining granular collections of bacteria similar to those seen in the liver. In some instances these collections of bacteria are in definite relation with necrotic areas, but this could very rarely be made out in the liver.

*Mesenteric glands.*—The amount of normal gland structure is very small. Almost the entire gland appears to be in a necrosed condition. In some areas the necrotic foci contain very large quantities of fragmented and destroyed nuclei. In other places very few of these are present. Among the necrotic areas are to be found, as in the liver and spleen, numerous epithelioid and lymphoid cells, some of these latter doubtless being cells which normally belong to the lymphoid glands. The areas of necrosis may possibly have been focal in origin, but in the section under observation they are so extensive that one coalesces with the other all over the gland. There are apparently no clumps of bacteria in this section under observation.

*Intestines.*—The lesions of the intestine vary. In all cases the superficial layer of the intestine seems to be necrotic to a certain extent, but this at any rate is doubtless due partly to post-mortem change. In the earliest stage of the disease to be made out in these sections, the lymphoid apparatus is tremendously swollen, the cells present in the swollen area no longer being apparently lymphoid in character, but many epithelioid cells are also present. All through the swollen area there are evidences of necrosis in the form of numerous nuclear fragments. In the earlier stages the muscular coat of the intestine

does not appear to be affected. The section which shows a more advanced stage of the disease shows that the progression consists mostly in the extension of the necrotic processes. In some instances the whole involved area is entirely necrotic, almost to the depth of the muscular coat, and there may be present beneath this necrotic material and between it and the muscular coat fibrin, in whose meshes are entangled polynuclear leucocytes and epithelioid cells. In this stage the muscular coat itself usually shows the presence of a few polynuclears and a large number of small round cells or epithelioid cells. Elsewhere in the swollen areas the necrosis is extensive, as in the mesenteric lymph glands. There is hardly an area in the section which has escaped it. In the later specimens the amount of cellular infiltration in the muscular coat is often very large, the muscle fibre being pushed widely apart by it, and in some places being distinctly necrotic over large areas. The infiltrating cells, under these circumstances, seem to be mainly small, round and epithelioid cells with an occasional polynuclear. Blue-staining collections of bacteria are seen in very large numbers in the deeper part of the necrotic areas in some of the sections.

*Bacteriologic Report.*—Coverslips from the mesenteric glands, spleen and bone marrow all show the presence of medium-sized, short, thick bacilli frequently occurring in clumps. Cultures were taken upon slant agar-agar from the heart's blood, spleen, lung, liver, mesenteric glands, kidney, and bone marrow.

The culture from the heart's blood, after 24 hours' incubation, contained four discrete pinhead-sized, gray-white, slightly elevated colonies. The morphologic appearances showed the presence of a bacillus of moderate length and thickness, apparently a pure growth. Culturally the organism behaved as follows:

*Litmus milk.*—No acidification or coagulation of the milk after six days' incubation in the thermostat at 37½° C.

*Potato.*—A moist, just perceptible growth along the line of inoculation.

*Bouillon.*—Diffuse cloudiness of the nutrient medium. Hanging drop preparations from young cultures show active motility.

*Gelatin stab.*—Whitish growth along the line of inoculation; no liquefaction of the gelatin.

*Dunham.*—Diffuse cloudiness of the medium. No indol reaction. No gas formation in saccharose, glucose or lactose media.

*Agar slant.*—Moderate, moist, whitish elevated growth. This organism, with the serum of an undoubted case of typhoid fever, showed a very positive Widal reaction in dilutions, varying from 1 to 30 to 1 and 50.

*Diagnosis.*—*Bacillus typhosus*.

The cultures from the spleen, liver, mesenteric glands and bone marrow similarly contained a pure growth of a bacillus, morphologically and culturally, like the organism isolated from the heart's blood. The typhoid bacillus was also isolated from the kidney associated with the bacillus coli communis. From the lung the colon bacillus was isolated in association with the staphylococcus pyogenes albus.

CASE II.—James R., aged 36, admitted into the Albany

Hospital, August 8, 1898, suffering from severe headache and pains in the arms and legs. The family history showed nothing of importance, and until the present sickness patient had always been quite well. Four days before admission he was taken ill with violent headache, fever, pains in limbs, and a slight chill. The following morning he went to his work, but felt so much worse that he went home and retired to his bed. The day before entering the Hospital he suffered from a nose-bleed, and had another on his way to the Hospital.

The physical examination shortly after admission was quite negative, but the temperature was 102.2° F. Later on in the disease the liver became slightly, and the spleen very much, augmented in size. The bowels remained constipated from the beginning of the disease, and at no time did the patient complain of abdominal tenderness at any point. There was some vomiting on several occasions, but at no time was the gastric derangement very severe. Toward the end delirium came on. The temperature throughout the disease varied between 99.8° F. and 103°, until the day before his death when the temperature reached 105.2° F. Death August 25th, 1898.

The autopsy notes are as follows:

Body 175 cm. long, moderately well built, considerably emaciated. Rigor mortis in both extremities. Pupils wide and equal; mucous membrane pale; post-mortem lividity of dependent parts. Abdomen tense and very distended, apparently with gas. Walls discolored; patches of greenish blue. Subcutaneous fat nearly absent. Muscles of thorax and abdomen pale and poorly developed.

*Peritoneum.*—Both layers smooth, glossy and free from injection. Omentum free from adhesions and contains a little fat; omental glands not enlarged. Intestines very distended with gas, particularly small intestines. Left lobe of liver visible below costal margin 5 cm. Stomach not apparent. Peritoneal cavity contains a small quantity of dark-colored, turbid fluid. Appendix measures 13.5 cm. in diameter, normal in appearance and free from adhesions; mesentery present throughout its entire length. Diaphragm fifth space on right side; sixth rib on left. Costal cartilages not ossified. Retro-sternal glands not enlarged. Both pleural cavities free from any excess of fluid.

*Pericardium.*—Both layers smooth; cavity contains no excess of fluid.

*Heart.*—Contains red and chicken-fat post-mortem clots, and is distended with fluid blood; normal in size. The endocardium of the right heart shows post-mortem discolorations. Tricuspid valve normal; also pulmonary and semilunar valves. The left heart shows areas of fatty atheroma in auricle; ventricle normal. Mitral leaflets very thick along their free edges. Aortic valves normal. Aorta just above valve shows areas of fatty atheroma. Coronary arteries patent; walls show large confluent patches of fatty atheroma. Heart muscle somewhat soft; on section, of a dark reddish-brown color (brown atrophy).

*Left lung.*—Bound down by old firm adhesions at the base and posteriorly. The pleura elsewhere is smooth. Lung crepitant; less so in normal than lower lobe. On section, the upper lobe is slightly congested; lower lobe markedly so and



contains quantity of blood-stained serum, which readily escapes. Bronchial mucous membrane congested and covered by a moderate amount of mucus. One portion of the upper lobe contains a pea-sized, firm calcareous mass embedded in the lung substance proper.

*Right lung.*—Bound down by old firm adhesions laterally and posteriorly. Lobes very much increased in consistency, but still crepitant. On section, the three lobes generally present a similar appearance, and contain a large quantity of blood-stained serum, especially the lower lobe, from which it runs off in abundance. The three lobes are markedly congested. Bronchi and blood-vessels similar to other side. In several places are a number of nodules very firm, sharp, and circumscribed, varying from a small shot to large pea in size. On section, these nodules are calcareous.

*Spleen.*—Free from adhesions. The organ is very large, measuring 16x6x10 cm. Capsule not wrinkled, and smooth. Consistency much decreased. Trabeculae not increased. Spleen pulp very much augmented. Malpighian bodies also very greatly augmented in size.

*Liver.*—Bound to the diaphragm and to the abdominal wall by adhesions. The organ is very much enlarged, measuring 26x20x8 cm. The capsule smooth. Consistency softer than normal. On section the organ is pale and cloudy (cloudy swelling).

*Gall-bladder.*—Distended with greenish-colored bile. Mucous membrane smooth and normal looking.

*Left kidney.*—Fatty capsule scanty. Fibrous capsule strips off fairly easily, occasionally tearing bits of kidney substance. The organ is somewhat enlarged. The surface is smooth; veins somewhat prominent. On section the cortex is practically normal in amount; markings quite prominent; glomeruli very distinct and congested. Medulla normal. Pelvis normal.

*Pancreas, adrenals and left ureter* are normal.

*Mesenteric glands* not enlarged, or only very slightly so.

*Aorta* shows occasional patches of fatty atheroma.

*Retro-peritoneal glands.*—Enlarged, but not markedly so.

The right adrenal gland occupies its normal anatomical position in relation to the surrounding viscera, but below it the kidney is absent. In its place is a small, somewhat firm, mass of tissue 5 cm. long and 2 cm. in thickness, and which, on section, presents a very peculiar appearance, in no manner suggestive of renal tissue. The ureter of this side leads to this mass.

*Bladder.*—Contains a small quantity of light, turbid urine. The walls are not increased in thickness and the bladder is of normal size.

*Intestines.*—The small intestines show no injection of the mucous membrane nor are the solitary follicles swollen. In the small intestine Peyer's patches show no evidence of being swollen or of other implication. No evidence of ulceration or cicatrization. The mucous membrane of large intestine is quite normal in appearance.

*Anatomical Diagnosis.*—Marked edema and congestion of both lungs; chronic adhesive pleuritis and healed (calcareous) tuberculosis of both lungs. Brown atrophy of heart. Ventral spleen tumor; cloudy swelling of liver and kidney; congenital

absence of right kidney; slight swelling of mesenteric glands; fatty atheroma of aorta; coronary artery disease.

The microscopic examination of the heart shows some fragmentatio myocardii in addition to the macroscopic findings; the lungs and kidneys microscopically show nothing very striking.

The following are some notes abstracted from the records of the microscopic examinations of the liver, spleen, and mesenteric glands:

*Liver.*—Capsule is normal in thickness. Connective tissue of the organ does not appear to be increased. The liver cells are swollen and rather indistinct. The nuclei are apparently, as a rule, well preserved. Scattered throughout the section in large numbers are circumscribed areas of focal change. In places as many as three of these can be seen under a low power. The appearance exhibited by these areas varies in different parts of the section. In some of them the process seems to be almost entirely necrotic in character, the liver cells in the area having lost their nuclei and taking rather an intense stain with the eosin. In these areas can be seen a few polynuclears and a number of small, round cells and cells of an epithelioid type. In other portions of the section the areas are extremely cellular and have the typical appearance of lymphoid nodules. In these instances the cells in such an area are either small or round cells, or rather long, irregular cells of an epithelioid type. There are no giant cells present, and the appearance of these nodules does not suggest tubercles. The nodules have apparently no connection with the vascular system of the organ. Besides these nodules, there can be seen occasionally in the liver substance patches of rather diffuse blue-staining material, which, under the high power, are seen to be composed of small rods, presumably bacteria. The hepatic vessels and the bile ducts are apparently normal. In one field one of the bacterial patches described above is present in one of the areas of necrosis, but as a rule no such association exists.

*Spleen.*—The capsule is not increased in thickness. Trabeculae appear normal in amount. The Malpighian bodies are rather large, but otherwise show no change. The pulp contains an excess of red-blood corpuscles, which are scattered irregularly among the pulp cells. Some of these can be seen to be inside of large phagocytic cells. In a few places in the substance of the pulp there are sharply localized areas in which the spleen substance has become necrotic. There are present in these areas a moderate number of cells; a few of which are polynuclears, the rest either small, round cells or cells of an epithelioid type. The blood-vessels of the organ present about a normal appearance.

*Mesenteric glands.*—Show extensive changes in the form of localized or diffuse areas of necrosis. These seem to be most marked in the central portions of the glands, but they are also present in the periphery. The necrotic areas stain rather sharply with the eosin, and contain large numbers of nuclear fragments, some polynuclear leucocytes, and a fair number of round cells and cells of an epithelioid type. In one or two places in the sections there are to be seen diffuse areas of blue-staining which, under the high power, are seen to be made up



of masses of bacteria. These have no connection in any of the sections examined with the areas of necrosis.

Sections of the liver, spleen, kidney and mesenteric glands, stained by Flexner's methylene-blue method, showed masses of bacilli, resembling, morphologically, the typhoid bacillus.

*Bacteriologic Examination.*—Cultures were taken at the time of the autopsy from the heart's blood, lung, liver, gall-bladder, spleen, kidney and urine. From all of these, with the exception of the kidney and urine, one single organism was isolated which, morphologically, was a somewhat short, moderately thick bacillus which decolorized by Gram's method of staining. It grew upon media as follows:

*Agar slant.*—Abundant, moist, white, elevated growth.

*Blood serum.*—A growth very similar in appearance to that on agar.

*Potato.*—A moist, slight, almost invisible growth.

*Bouillon.*—A diffuse cloudiness. Hanging-drop preparations show a well-marked motility of the bacillus.

*Dunham.*—A diffuse cloudiness; no indol reaction could be obtained.

*Litmus milk.*—After several days it acidified milk, but failed to produce any coagulation.

*Gelatin stab.*—Moderate white growth along line of inoculation, but no liquefaction of the gelatin.

No gas formation in saccharose, lactose or glucose media.

Cover-glass preparations, stained by Pittfield's method, showed the flagella with a peritrichal arrangement. Tested with known typhoid serum, the bacillus produced a typical Widal reaction in 12 minutes with a dilution of 1 to 10; in 42 minutes with a dilution of 1 to 100.

*Diagnosis.*—*Bacillus typhosus*.

The cultures from the kidney and urine contained the typhoid bacillus, but associated with an organism giving all the tests for the *bacillus coli communis*.

The possibility of the existence of typhoid fever without intestinal lesions was long since conceived by Louis<sup>10</sup>, who, himself in Observation 52 of his book, reported an instance that during life presented a typical clinical picture of typhoid fever. The patient died on the 55th day of his disease, and the necropsy showed absolutely no existence or evidence of recent implication of the intestinal canal. The belief of the occasional existence of typhoid fever without anatomic intestinal changes was entertained by a number of the earlier clinicians after Louis, but the clinical simulation of enteric fever by other maladies necessarily, in the absence of bacteriologic criteria, makes these reported cases less valuable as contributions to the study of this rare type of typhoid fever. The conclusive demonstration of this form, without intestinal lesions, dates since the discovery of the specific organism of etiologic importance, and more especially from the time when the differentiation of the typhoid bacillus from allied species became more firmly established. In addition to the reported cases of Banti<sup>11</sup>, Karlinski<sup>12</sup>, Guarnieri<sup>13</sup>, Vaillard<sup>14</sup>, Chantemesse<sup>15</sup>, and Vincent<sup>16</sup>, other instances carrying more conviction have been published by more recent writers.

DuCazal<sup>17</sup>, in 1893, reported the case of a young man, 21 years of age, who had been ill for fifteen days before entering the Hospital. The clinical history suggested typhoid fever,

subsequently complicated by double pneumonia. At the autopsy the principal lesions were pneumonia of both lungs and acute spleen tumor. The intestines showed absolutely no evidence whatever of any anatomic alterations, but the cultures from the spleen contained bacilli, morphologically similar to, and on media behaving like, Eberth's bacillus. Kühnau<sup>18</sup> some years later published an interesting observation of this kind. The patient was a pregnant woman, 32 years old, who developed typhoid fever with the subsequent development of erysipelas of the face. Bacteriologic examination of the blood during life showed typhoid bacilli, as already mentioned. The woman died, and the post-mortem examination showed enlargement and necrosis of mesenteric glands, abscesses of the kidneys and thrombosis of one of the ovarian veins. The intestines were free from any lesions whatever. The bacillus typhosus was cultivated from the kidneys, mesenteric glands and spleen.

The case of Pick<sup>19</sup> was that of a 23-year-old woman, who died in the fourth week of a typhoid fever. During life the Widal reaction was positive. The anatomic diagnosis of the autopsy was: Typhoid infiltration of the mesenteric lymph glands, parenchymatous degeneration of organs, and left-sided lobular pneumonia. The spleen was not enlarged and the intestines were free from lesions. The serum test after death was positive in 1 to 10; cultures from the gall-bladder and mesenteric glands contained the typhoid organism; that from the spleen was negative.

Meunier<sup>20</sup>, at the séance of the Société Méd. des Hôp. de Paris of April 7th, 1897, reported an uncommon observation of typhoid infection in a boy, 8 years of age, suffering from acute miliary tuberculosis. Shortly after admission into the Hospital rose-spots appeared and the application of the Widal test gave a positive reaction. The lesions found at the necropsy were tubercular ulcers of the intestine. Typhoid bacilli were demonstrated in the cultures from the spleen, lungs and pleural exudate.

Beatty<sup>21</sup>, about the same time, published a case of typhoid fever, commencing with nausea and pain in the back followed by jaundice. Death on the sixth day. The examination after death showed an enlarged spleen and mesenteric glands, but in the intestines there was an absence of lesions. The spleen contained typhoid bacilli.

Chiari and Kraus<sup>22</sup>, in a very recent and valuable article, have discussed the subject very exhaustively and reported seven cases of atypical typhoid infection, in which there was an absence of anatomic lesions of the intestines. These observers classify enteric fever into four great anatomic divisions: The first include all those cases presenting the characteristic typhoid lesions; the second those anatomically atypical but, nevertheless, recognizable cases on the autopsy table; the third comprising that class of cases characterized by an absence of anatomic lesions, making the diagnosis, anatomically, impossible, but in the organs of which typhoid bacilli are found; and finally, the last group to include such cases as cannot be diagnosed anatomically or bacteriologically, but which give positive serum reaction with the Widal test. Group III, of this classification, is of particular interest to us, inasmuch as the Case II, reported in our paper, belongs to this class. The

typhoid septicæmias frequently fall under this heading. Of the five cases reported by Chiari and Kraus as belonging to this group, only three were based on the presence of the typhoid bacilli in one or more of the organs. The diagnosis of Cases XV and XVI is entirely based on a positive result of the serum test, no typhoid bacilli having been demonstrated in any organ. Although, with proper precautions and in sufficiently high dilutions, the specificity of the serum reaction is almost absolute, nevertheless certain errors must necessarily arise at times, and these become increasingly great as the dilution is made lower and lower. Chiari and Kraus used dilutions of 1 to 10 and 1 to 12, degrees of dilution particularly susceptible to fallacious results. In view of this, Cases XV and XVI lose much of their interest as examples of typhoid fever without intestinal lesions. These remarks likewise, in our opinion, apply with equal force to Case XVIII and all the cases of group IV, the diagnosis of all of which being based on the serum reaction with very low dilutions.

Flexner and Norman Harris (53) very recently have contributed a very carefully studied additional example of typhoid infection without intestinal lesions. The case was that of a man, 68 years of age, who suffered from shortness of breath, symptoms of pleuritis, and finally died two days after admission into the Hospital. The autopsy, performed one hour after death, showed thrombosis of pulmonary artery, gangrene of lung, perforation of pleura, pyo-pneumo-thorax, acute spleen tumor, parenchymatous degeneration of liver and kidneys. The mesenteric glands were not swollen, and the intestines showed nothing abnormal. The bacteriologic examination demonstrated the presence of typhoid bacilli in liver, spleen and lung.

Examples of typhoid fever, without intestinal implication, are not entirely limited to adults, but, on the contrary, the apparent small disposition to intestinal lesions of very young children suffering from this disease is one of considerable interest in this connection. Chantemesse and Widal (54) called attention to the trivial character of the intestinal lesions in the young some years ago; and Brouardel and Thoinot (55) likewise mention this peculiarity, as does also Marfan (56). The publications of Etienne (57), Freund and Levy (58), and others, include cases of this character in which the intestinal lesions were at a minimum or totally absent.

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CAVITIES IN THE BRAIN PRODUCED BY THE *BACILLUS AEROGENES CAPSULATUS*.

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Reports of cases of subcutaneous and visceral invasion by gas-forming bacilli are multiplying rapidly. Chas. Norris' has given the most recent monograph on general infection by the *bacillus aerogenes capsulatus*. He reviews most of the recent literature and enters especially into bacteriological experimentation. The following case is of interest because the bacilli seemed to have had a predilection for the brain.

## HISTORY OF CASE.

Mrs. C. B. Age, 35. Colored. Admitted to the Surgical Ward of the Maryland General Hospital, suffering from shock caused by a gunshot wound of the abdomen. Prof. J. D. Blake was summoned and performed a laparotomy, suturing several perforations of the intestine. The bullet was not found. After applying the dressings the patient was put to bed and rallied from the operation very well. There was a slight rise of temperature the first day, but this soon subsided and it seemed as though an uneventful recovery would ensue. There was no pain or distention of the abdomen. Temperature and pulse normal, bowels constipated. On the third day a change in her condition was noticed. She seemed to be getting weaker without any appreciable cause. In a few hours after the change was noticed she quietly passed away. At the autopsy, which was performed 24 hours after death, the following condition was found: Body that of a strongly built and well-nourished negro woman. Rigor mortis marked. No crepitation of subcutaneous tissue. On opening the abdominal cavity the viscera appeared normal. The perforations were healing nicely; no indications of peritonitis. The bullet was found in left iliac muscle. On section of the various organs there were no appreciable signs of gas formation except in the uterus. Here a number of small spaces were seen. No gas could be detected, and on microscopical examination no bacilli were found. The heart and lungs were normal. The dura mater was found closely adherent to the calvarium. The brain was removed, surrounded by its meninges, and placed in a 4 per cent. solution of formalin to harden, before sectioning. The spinal cord was not removed. The external aspect of the brain was normal, the sulci and gyri being especially well marked. After the brain was thoroughly hardened (4 to 6 days), horizontal sections were made from the base upward, which revealed the following condition:

In the right hemisphere there existed a large cavity, involving the external capsule in its entirety, being five centimeters long, one centimeter broad and two centimeters deep, which appeared to be lined by a smooth glistening membrane. A small amount of bloody serum was found in it. Throughout the lenticular nucleus numerous small cavities were found, varying from one-half to one centimeter in extent. The anterior limb of the internal capsule, on a level with the middle commissure, contained several cavities,

also a small one in the optic thalamus. Another section made on a level with the velum interpositum showed the posterior limb of the internal capsule to be almost completely destroyed by two large cavities. None of these spaces communicated with the ventricles. The caudate nucleus was intact. In the external orbital convolution a large cavity existed, being three centimeters deep and one centimeter broad, apparently lined by a smooth membrane.

Left hemisphere was smaller than the right. The first section revealed a cavity in the anterior limb of the external capsule two centimeters long and one centimeter deep. In the posterior limb 3 to 6 small pits or depressions were seen. In the lenticular nucleus several large excavations. The fibres of the internal capsule on this side seemed to pass around the cavities. The caudate nucleus and optic thalamus were normal. The cavities on this side were not as large nor as extensive as on the opposite side. The sulci and gyri were especially well marked, the former being very deep. No cortical or subcortical lesions were found. On section the cerebellum showed a few small subcortical cavities in the arbor vitae, superior surface. Otherwise, it was normal. After seeing this honeycombed appearance of the basal ganglia, the question immediately arose as to the cause. Was it congenital or acquired? Could the woman have lived in this condition without manifesting any symptoms of cerebral trouble? Could it be porencephalia? Was it produced by formaldehyde? These and numerous other surmises were not answered until sections were made and examined microscopically.

We submitted several sections to Dr. Barker, who at once recognized the bacteria as the cause of the cavity formation.

On studying sections under the low power of the microscope, the edges of the cavities appear quite smooth, and the clean-cut appearance seen in the gross sections of this brain again shows itself. They are devoid of any membranous or epithelial lining. Indeed, some of these cavities are surrounded by comparatively normal tissue, the brain cells in some instances forming the very edge. This is, however, an exception; for surrounding most of them is an area of cell degeneration of variable thickness, which is easily recognized by the absence of nuclear staining; indeed, the absence of all cellular structure is frequently seen in this zone, so that a diffuse homogeneous staining with eosin divides this from the zone to be described next. On passing outwards, this advanced stage of degeneration is gradually superseded by one in which only a partial loss of nuclear staining is evident and staining of the individual cells appears. Lastly, this zone merges into normal brain tissue. As for the spaces themselves, they are usually quite empty, excepting for certain masses which take on a deep hæmatoxylin staining and under the low-power lens have a somewhat granular appearance; not infrequently these masses lie imbedded in the



walls of the cavities; but what is especially striking, is that by far the majority of the capillaries in the section are completely filled by them. When examined under a higher lens (No. 7 or oil immersion), it becomes evident that these darkly staining masses, just mentioned, represent aggregations of bacilli, and, as far as we can judge from microscopical appearances alone, they are pure growths of a bacillus having the following morphology:

A fairly long, rather thick, bacillus, varying at times in either dimension, at times in both, with an average length from 3 to 6 mm., and with the comparative thickness of the anthrax bacillus; its ends are slightly rounded; the organism occurs singly, in pairs and clumps, and in parts of these specimens as chains. It stains with the ordinary aniline dyes; also by Gram's method. No spores were found, but no special stain was used for their demonstration. The bacilli frequently lie free in the tissues at some distance from cavities, and their clumps are almost invariably surrounded by zones of cellular degeneration, such as have been described surrounding the cavities; similar cellular changes are frequently seen in the neighborhood of bacilli which lie within blood-vessels. Judging from these specimens it would seem that the veins and capillaries are especially active in carrying the organism, for those arteries with well-marked walls showed as a rule, with one or two exceptions, no bacilli in their lumina. As to the part played by the lymphatics in such a conveyance it is difficult to say; we believe they played a minor rôle in this case. In none of the perivascular lymph spaces (space of His) could we find the organism.

In no portion of the specimen were there any changes pointing to an inflammatory reaction, the entire absence of small-cell infiltration being very striking.

There are no hemorrhages in the brain tissue, nor could we detect the presence of blood in the cavities.

The arteries throughout are normal, showing no evidence of sclerosis. Any attempt at repair was entirely wanting, there being no neuroglial hyperplasia nor formation of granulation tissue.

#### CONCLUSION.

We believe that the cell degenerations and cavity formation in this case are due to the presence of the bacilli described, and that they belong to the class of gas-forming bacteria, the gas formation being directly responsible for the presence of the cavities, and the cellular changes being due to the action of toxins.

In 1892 Welch and Nuttall<sup>2</sup> reported in the July-August number of the Johns Hopkins Bulletin their discovery of a gas-forming bacillus obtained from the emphysematous tissues and blood of a man dead of aneurism of the aorta, for which they proposed the name, *bacillus aerogenes capsulatus*. Gas bubbles were abundantly present in the internal organs, notably in the myocardium, the liver, spleen and kidneys. This gas burned with a pale-bluish, almost colorless flame, a slight detonation being heard at the moment of ignition.

Upon microscopical examination of these organs, they found around masses of bacilli frequently, but not always, a disappearance of the nuclei and degenerative changes in

cardiac muscle cell, and the epithelial cells of the liver and kidney, especially in the neighborhood of gas cavities, in the walls of which the bacilli were often densely accumulated.

They describe the *bacillus aerogenes capsulatus* as follows:

The bacillus is non-motile, straight or sometimes slightly curved, variable in size, but averaging about the thickness of the anthrax bacillus, and from 3 to 6 cm. in length, with adjacent ends slightly rounded or sometimes square cut; occurs singly, in pairs, in clumps, and sometimes in chains, and stains readily with the ordinary aniline dyes, and after using Gram's method, staining is either uniform or with small unstained spots, less frequently with isolated deeply staining granules.

Capsules, although not constant, were frequently demonstrated, especially by Welch's method for staining capsules in specimens from the animal body and sometimes from agar cultures. No spores were found either in the animal body or in cultures.\*

The bacillus grows upon all ordinary culture media under anaerobic conditions, at body temperature slowly; at 18 to 20 C. no growth on surface of solid media under ordinary conditions. Gas is produced in all cultures containing fermentable material. Time and space will not permit us to describe the cultural characters more in detail, and those interested in this subject are referred to the original paper and also to that of Welch and Flexner in the Journal of Experimental Medicine, Vol. I. This organism is non-pathogenic to rabbits even when a pure culture is injected into the circulation.

If the animal is, however, killed immediately or soon after intravenous injection, after 4 to 6 hours at 30 C., or about 18 hours at 18 or 20 C., there follows great gas formation in the blood-vessels and organs and the bacilli are found abundantly in these tissues.

Although we cannot prove in the absence of cultural growths of the organism found in this brain that the bacillus under consideration is identical with that described by Welch and Nuttall, there seems to be little doubt from the resemblance in morphology, staining characteristics and more especially in its reaction to Gram's method, and last but not least, in the changes which it produces in the tissues, that this organism is at least closely allied to the *bacillus aerogenes capsulatus* and probably identical. As animal experiments show this organism to be non-pathogenic, and clinical experience, with a single exception, tends to show that general infection with this organism takes place immediately before or after death, practically the latter only, as far as can be judged from the symptoms due to general gas formation in the body; and further, as there is no evidence in this case which points to a general infection by this organism, before the death of the individual, we concluded that the changes occurred post mortem, the distribution of the organism most likely occurring in the preagonal period. The organism not infrequently produces localized emphysematous conditions only in the tissues, from which recovery usually takes place because it seems essential for the existence and growth of this organism

\* Since this publication Durham has found that this organism produces spores when grown on blood serum.

that the tissues must have been previously injured or that the blood-supply should be poor in oxygen. That an injury may be trivial and still favor its development seems quite clear from two cases reported by Fraenkel,\* in which infection followed hypodermic injections, in one case after the injection of camphor, oil and ether under the skin, and in the other of a dilute solution in water of sulphuric acid and chloride of morphia. One of these cases pursued a rapidly fatal course, death occurring two days after the injection. Before the discovery of this organism the cause of death in such cases would very likely have been attributed to the entrance of air into a vein. Welch and Nuttall in their original paper expressed the belief that many of the deaths attributed to the entrance of air into the veins would prove to be cases of gas bacillus infection, and especially referred to cases occurring in obstetrical practice in which it was supposed that air had entered the uterine cavity and had been absorbed by the uterine sinuses thus causing fatal air emboli. Perkins' reports such a case following an attempt at criminal abortion, and attributed the fatal outcome to air embolism. Dr. Dobbin,<sup>4</sup> of the Johns Hopkins Hospital, through the kindness of Dr. Perkins, had an opportunity of studying sections from the uterus in this case and found the characteristic lesions of gas bacilli infection, the bacilli corresponding in morphology and staining characters to the bacillus of Welch and Nuttall.

The "Schaumorgane" of the Germans are due to such infections and the elaborate article of Ernst<sup>5</sup> on the "Schaumleber" is especially rich in the microscopical changes in the tissues. He describes the microscopical appearance of the "Schaumleber" as follows: "On making the usual single long transverse section through the liver, the two portions thus formed fell apart almost immediately, and while examining these gas bubbles I saw that they began to appear from the larger vessels soon in such numbers that hillocks of froth were formed on the surface of the section; these hillocks gradually coalesced. If these masses of froth were stripped away, hardly a few minutes passed before fresh ones had formed. This condition of re-formation of froth continued for a long time. The autopsy had been performed 3 hours after death and there were no evidences of decomposition."

In reviewing the literature on this subject one clearly sees that these infections with gas-forming bacteria are becoming more widely recognized, and the number of articles have increased every year since the appearance of those of Welch and Nuttall and that of Ernst. In fact, at present the changes due to these bacteria have been described in almost every organ, including, for instance, the liver, spleen, stomach, intestines, bladder, kidney, uterus, skeletal muscles, etc. Notwithstanding this, we have been unable to find any description of pathological changes attributed to these bacteria in the brain or spinal cord, which seems indeed strange if one considers the comparative frequency of these infections and that they are fairly well recognized by observers in general. One can hardly believe that the central nervous system should be spared from such changes in cases of general infection where almost all organs may show the presence of gas cavities. Of course that the liver, spleen, and perhaps the uterus may pre-

dominate in showing the presence of these cavities when once the general circulation conveys the organism is not difficult to understand, for as the veins seem to be especially employed in such a conveyance it is no more than natural that organs which are abundantly supplied with large veins and therefore containing a large amount of the blood after death would contain a relatively greater number of the organism than an organ in whose parenchyma the veins were less abundant and the venous radicles of small calibre. The brain and cord can certainly be classed with those organs possessing a comparatively small amount of blood in their parenchyma after death; of course the membranes covering them must be excluded, for in these the veins being large, and containing a large amount of blood, in all probability an examination would, in the great majority of instances of general infection, reveal the presence of the organism. Of course the smaller venous radicles of the brain parenchyma would also contain a fair number of the organism, but these might be present in insufficient numbers to produce sufficient gases to give rise to appreciable microscopical lesions. We refer here, of course, more especially to cavity formation. The above is only a theory intended to cover the inference that probably in a great number of cases of gas bacillus infection showing gas cavities throughout the organs, the brain and spinal cord will in the great majority be spared. But in looking over the articles on this subject one can easily see why such changes in the central nervous system should have been overlooked and that in the report of cases coming to autopsy we have been unable to find, with one or two exceptions, any mention of a removal of the brain or cord, and it is more than likely that this was neglected, for had they been examined mention of this fact would undoubtedly have been made—this of course is a very evident reason for the non-recognition of similar changes as are described in this brain. Although this is, as far as we know, the first case in which cavity formation has been attributed in the brain to the presence of gas bacilli we do not claim that such changes have not been described before, but they have been explained by different etiological factors. Of such an instance we have found but two clear examples; both the brains are described by the same observers, namely, by G. H. Savage<sup>6</sup> and W. Hale White, in an article entitled "Causes of Holes in the Brain," appearing in the Transactions of the London Pathological Society, Vol. XXXIV, 1882. These brains the authors obtained from two general paralytics, and as the kidneys, liver, lungs, and heart muscles contained cysts, they very naturally describe the changes by the term of "Universal cystic degeneration." In reading this article one is struck with the admirably clear description of the pathological changes. The illustration of the brain presented herewith shows a picture almost identical with the one reported by us, so that we feel little hesitancy in ascribing the changes described by Savage and White to the bacillus aerogenes capsulatus or an allied organism. A short résumé of the description of the brains and the changes in the other organs will not be out of place.

"Taking first the kidney, sections appear to show that in our cases . . . the cystic change is due to dilatation of either the Malpighian capsules or cortical tubules. And in the liver . . . the cysts appear to be due to small vacuoles in the



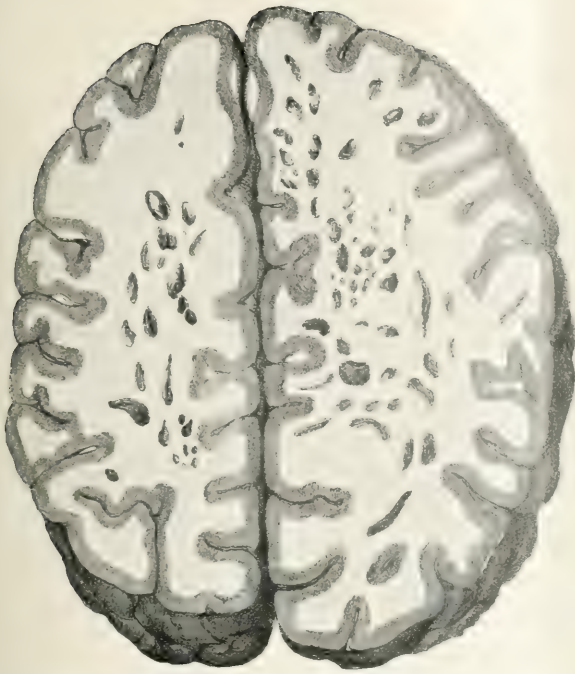


FIG. 2.—Reproduction of section of brain from Hale White and Savage's case of "General Cystic Degeneration." [Transactions of Pathological Society of London, Vol. XXXIV.]

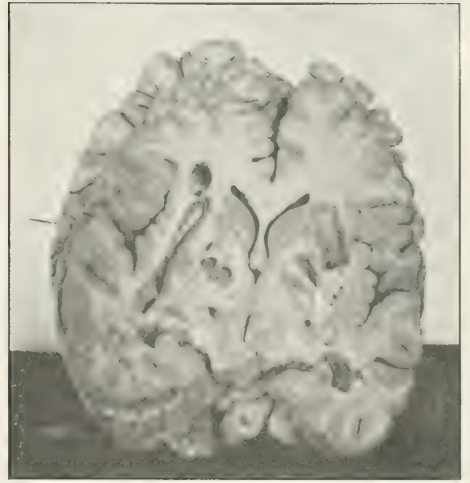


FIG. 1.—Photograph showing cavities in the corpus striatum.

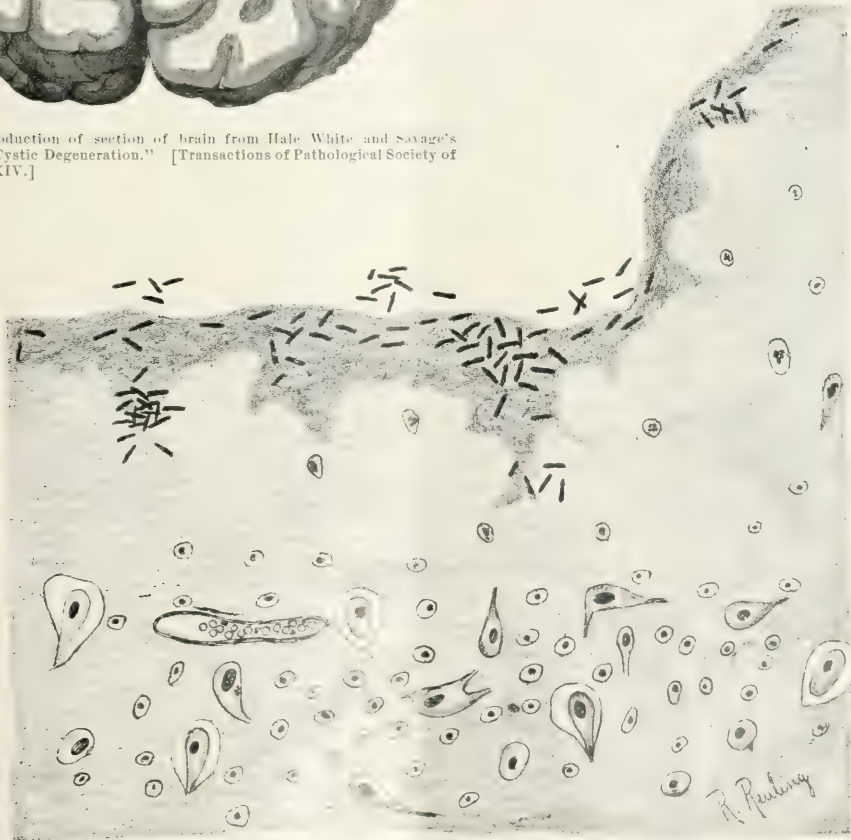


FIG. 3.—Section showing edge of large gas cavity (left). Surrounding this is an area of cellular degeneration. (Immersion lens.)





hepatic cells, which we have proved not to be fatty by their refusal to stain with osmic acid. The several vacuoles in the same cell, by increase in size, run together to form one that occupies nearly all the cell, which being so distended bursts. The vacuoles of adjacent cells thus coming together soon form one large cyst. . . . By this process in parts of the liver the cysts produced are so numerous that the whole organ has the appearance of a sponge; this is very well shown on holding up one of the microscopic slides. . . . We do not think the hepatic cysts have any true wall, but the appearance of one is often produced by the cyst in the course of its enlargement coming in contact with some fibrous tissue, which it stretches and pushes before it, so that at last it appears to have a thin lining membrane."

"Lungs—The cavities are mostly circular and not connected with bronchial tubes; they contain no lining membrane. They have a tendency to occur in groups, and seem to be situated indiscriminately among the air-cells, from which they are distinguished by their regular shape and containing no granular epithelial debris, but in many cases the cysts have in the interior a peculiar amorphous matter which takes the logwood stain with great brilliancy."

Before going any further we wish to call especial attention to the mention of this "amorphous matter" which takes on the logwood stain so deeply, which the authors describe in the cavity of the brain and in the vessels of the different organs; this seems especially important as this "amorphous matter" which they describe is undoubtedly composed of masses of bacteria which the reader will remember often completely filled the vessels in the brain we describe and were so abundant in the walls of the cavities. Savage and White give only a short description of the appearances of the brain, but substitute for this a good illustration of the specimen. The description of the microscopical appearances of the brain cysts corresponds in all particulars to those found in the other organs. It would be useless for us to go into a minute comparison of the changes described in the case reported in this article and the other pathological conditions giving rise to cavity formation in the brain. One could hardly, after a careful consideration of such conditions as pencephalia which has been so admirably treated by Kundrat<sup>1</sup> to which the reader is referred—the condition known as *état criblé*<sup>2</sup>—is now considered by most observers as of no pathological significance and the holes in this are extremely small, generally of pinpoint size and are frequently due to slight dilations of the Virchow-Robin lymph space, or by a shrinkage of the brain substance from the action of hardening fluids, causing a rather wide separation between vessels and parenchyma.

The holes produced in sclerotic processes found at times in the brain of general paralytics, and patients suffering from multiple sclerosis, could hardly take a form to resemble those cavities produced by this organism, as the former would almost necessarily contain a lining membrane, and evidences of neuroglial hyperplasia in different localities would speak for the chronicity of the process.

#### DISCUSSION.

DR. WELCH—In connection with Drs. Herring and Reu-

ling's contribution, it may be of interest to exhibit a microscopical section from a pig's liver which I examined to-day. I received the section from an eminent pathologist who was puzzled by the appearances. Two or three of the superficial lobules of the liver presented to the naked eye small, bleb-like spaces. The sections show a honeycombed appearance of the affected lobules, caused by an abundant development of bacilli identical, morphologically, with the *B. aerogenes capsulatus*. The gaseous spaces are sharply defined, and the appearances are indeed such as to be very puzzling, unless one is familiar with the blebs produced by the post-mortem development of our gas bacillus. The specimen is an example of emphysematous liver (Schaumleber), but is remarkable on account of the limited production of gas and the circumscribed arrangement of the holes, due in part to the large amount of connective tissue normally surrounding the hepatic lobules of the pig.

In the light of Drs. Herring and Reuling's observation, it is probable that certain cases reported in the literature as holes in the brain are really due to the post-mortem development of the gas bacillus.

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# ACUTE FIBRINO-PURULENT CEREBRO-SPINAL MENINGITIS, EPENDYMITIS, ABSCESSSES OF THE CEREBRUM, GAS-CYSTS OF THE CEREBRUM, CEREBRO-SPINAL EXUDATION, AND OF THE LIVER, DUE TO THE BACILLUS AEROGENES CAPSULATUS.

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(From the Pathological Laboratory of Lakeside Hospital.)

For the clinical history of the following case my thanks are due to Dr. Dudley P. Allen. H. E., male, white, aged 31 years, was admitted to Lakeside Hospital, service of Dr. Allen, March 22, 1898. His family history was without interest. The patient had had chicken-pox and scarlet fever, but denied syphilis.

In August, 1897, he contracted gonorrhœa, and shortly after this he noticed a painful swelling in the perineum. Six months later this ruptured, with the discharge of a considerable amount of pus. After this there was a permanent urinary fistula at this point. Three months after the occurrence of the first swelling another formed in the same region, and after the escape of pus healed and disappeared.

With the usual precautions under ether anesthesia Dr. Allen curetted the fistulous tract which communicated with the urethra. After dilatation of the urethra a catheter was inserted and the wound allowed to heal.

A few days after the operation the patient became unconscious, developed symptoms of meningitis and died during the night of March the 29th, 1898. After the operation the temperature ranged between 99° and 104°, reaching 105° F. before death.

A few minutes after death the body was placed in a cold-storage chest kept constantly at 32° F.

The autopsy was begun ten hours after death.

**Anatomical Diagnosis.**—Operation for cure of perineal fistula. Acute fibrino-purulent cerebro-spinal meningitis and ependymitis, with abscesses of the cerebrum, gas-cysts in the cerebrum, cerebro-spinal exudation and in the liver, septicæmia (?), due to the bacillus aerogenes capsulatus; fatty degeneration of the liver, heart and kidneys; cloudy swelling of the kidneys.

The body was 182 cm. long, the surface cold, rigor mortis was marked. There was no œdema and no emphysematous crackling of the subcutaneous tissues. The abdominal muscles were well developed. The peritoneum was smooth and glistening. The pelvic cavity contained a small amount of slightly blood-tinged fluid with a few gas bubbles. The abdomen was not distended.

The chest was well shaped. The pleural cavities and the pleuræ were normal.

Both lungs were enormously congested and showed small areas of consolidation. On section a large amount of dark fluid-blood containing gas bubbles escaped. Gas bubbles escaped from the pulmonary vessels on pressure. The mucous membrane of the bronchi was deeply congested. The lungs were moderately pigmented. The bronchial glands were pigmented, but were free from tuberculosis. The mucous membrane of the trachea and larynx was congested.

The pericardium was negative. The heart was of ordinary size. The myocardium was pale. In the right auricle and auricular appendage and the right ventricle there were dark fluid-blood and loose clots, with a large number of large and small gas bubbles. The valves and coronary vessels were normal.

The liver was of ordinary size and its capsule smooth. On section a large amount of dark red blood containing large and small gas bubbles escaped from the hepatic and portal veins. The lobules were well marked; the consistencies were not specially increased. Scattered throughout the organ there were a large number of small opaque areas the size of a pin's head. The bile-ducts and the gall-bladder were negative.

The spleen was four times the ordinary size. The capsule was not thickened. On section the organ was soft, dark red in color and markedly hyperæmic. The Malpighian bodies and the trabeculæ were obscure. A large number of gas bubbles escaped on section.

The kidneys were of ordinary size. The capsules were readily removed. The surfaces were pale. The cortices were somewhat thicker than ordinary, and the glomeruli and veins were markedly congested. There were no gas bubbles to be found in the kidneys. The adrenals were negative.

The pancreas, œsophagus, stomach and small intestines were markedly congested. The colon and rectum showed nothing of interest. The testicles were negative. The urethra was normal; there was no stricture to be found. The perineal wound was healed, and no pus and no gas bubbles could be found. The right lobe of the prostate was larger than ordinary. No abscesses were found. The bladder was distended with urine. The mucous membrane was moderately congested; there were no ulcers. The pelvis was deep and narrow. Careful dissection failed to show any focus of suppuration. The pelvic veins, the inferior vena cava and the portal vein all contained large and small gas bubbles.

**Head.**—The scalp was of ordinary thickness and moderately congested. The skull was normal. The vessels of the dura-mater were moderately congested. The sinuses contained dark fluid-blood with large and small gas bubbles.

**Brain.**—The vessels of the surface of the brain were very much congested. The pia-arachnoid over the cerebral hemispheres showed a number of small opaque areas of fibrinous exudation. The structures at the base of the brain, including the nerves, were bathed in a thick yellow pus. The pia-arachnoid over the inferior surface of the cerebrum, a large portion of the cerebellum, the pons and the medulla were covered with a thick fibrino-purulent exudation.

On section of the left cerebral hemisphere just above the



Sylvian fissure, involving the intra-parietal fissure, and the ascending parietal and the supra-marginal convolutions, there was an abscess with soft, necrotic walls. This abscess varied from 0.5 to 2 cm. in diameter. Near this abscess at one side there were a number of smooth-walled cavities measuring from 1 to 5 mm. in diameter.

On the inner side, this abscess extended deep into the tissue. Occupying the anterior half of the left superior temporo-sphenoidal convolution there was an irregular abscess with soft necrotic walls. The abscess cavity was filled with a semi-fluid necrotic material. This abscess varied from 0.5 to 1.5 cm. in diameter. Both of these abscesses extended inwards and communicated with the left lateral ventricle. Nearly the whole of the surface of this ventricle was covered with a thick layer of pus and the wall over a large surface was necrotic. The lenticular nucleus of the left side contained a number of small smooth-walled gas-cysts or cavities varying from 1 to 5 mm. in diameter. In the internal capsule there were several similar gas-cysts. The right lateral ventricle, the right cerebral hemisphere, the cerebellum and the pons and medulla showed nothing abnormal on section.

*Spinal Cord.*—The dura mater was moderately hyperæmic. The vessels of the pia-arachnoid were hyperæmic and contained small gas bubbles. In the membranes there were gas-cysts from 1 to 3 mm. in diameter. The cord was of ordinary consistence and appeared normal.

*Bacteriological Examination.*—Coverslip preparations made from the lungs, heart, venæ cavæ, portal vein, pelvic veins, liver, the cerebral and spinal exudations, and the brain abscesses, showed in great numbers and in pure culture a large stout bacillus often in pairs, threes and fours end to end, and usually with capsules. Careful study of the meningeal exudate failed to demonstrate the presence of any other bacteria. Half a cubic centimeter of this pus was injected into the ear-vein of a rabbit. The animal was killed a few minutes later and put in the incubator. After five hours the animal was enormously swollen, its subcutaneous tissues being emphysematous. At the autopsy gas was found in the heart and blood-vessels and in all the organs. Capsulated bacilli similar to those injected were found in pure culture in the various organs.

At the autopsy plate and slant cultures were made on glucose agar and upon slanted coagulated blood serum from the brain abscesses, the meningeal exudate, the heart's blood, and from the liver, lungs, spleen, kidneys and portal vein, were grown both aerobically and anaerobically (Novy's jars).

The aerobic cultures were sterile after three days in the incubator. All the anaerobic cultures showed, after 24 hours in the incubator, numbers of grayish-white colonies, which after a few days were from 2 to 3 millimeters in diameter. In gelatine cultures slow liquefaction of the medium occurred. Milk was coagulated in forty-eight hours. There was slight visible growth with gas formation on potato. Sugar bouillon was rendered diffusely cloudy. The organism was non-motile. In blood serum-cultures spores were found.

The bacillus produced gas in media containing fermentable substances. Cultures of this bacillus were pathogenic for guinea-pigs and pigeons. Rabbits killed after intravenous

inoculation and kept in a warm place always showed marked emphysematous swelling with typical "Schaumorgane." This bacillus stained well with the aniline stains and by Gram's staining method.

From the brain abscess and the meningeal exudate, then, as well as from the various organs there was obtained in pure culture a bacillus identical with the bacillus aerogenes capsulatus (Welch).

#### MICROSCOPICAL EXAMINATION OF THE ORGANS.

The brain and spinal cord were hardened in 10% formalin, and portions of the other organs were hardened in Zenker's fluid and in 95% alcohol.

*Central Nervous System.*—Sections made from the cerebral and cerebellar cortex, from the pons and medulla and from the spinal cord, and from the brain abscesses were stained in hematoxylin and eosin, in eosin and methylene-blue, in thionin, and in carmine followed by Weigert's fibrin stain. A study of the meningeal changes showed marked dilatation of the blood-vessels. Many of the small arteries were filled with both polymorphous and mononuclear leucocytes. In some vessels the endothelium was partially or totally desquamated and the sub-endothelial tissue infiltrated with cells, and well marked thrombosis was found in some arteries. In some vessels both polymorphous and mononuclear leucocytes could be seen in the media and adventitia. In some places there was proliferation of the cells of the adventitia with the formation of large round or spindle-shaped cells. Only a few bacilli were seen in the vessels, but in places numbers were found in the adventitia. The exudation varied very much in thickness, being thickest at the base of the brain over the cerebellum, the pons and the medulla. The most numerous cells were polymorphous nuclear neutrophils. Besides these there were many mononuclear cells of varying size and answering to the description of plasma cells. In addition to these in some places large round or oval mononuclear cells of the connective-tissue type were seen. Here and there a few red-blood cells were found. In some places the exudation was rich in fibrin, while in others this was scanty.

In many places on the cerebral and cerebellar cortex, proceeding along the course of the vessels in the *sulci*, there was a marked infiltration with polymorphous nuclear leucocytes and plasma cells. The exudation was, in general, rich in fibrin. The blood-vessels were dilated, and many of the arteries showed the same changes described in the meningeal vessels. In these areas bacilli were always found. In some of these broad bands of cellular infiltration in the cerebellum gas-cysts of varying size containing bacilli were seen.

Sections of the cord made at different levels showed well-marked meningitis. The exudation was most marked in the cervical and upper dorsal regions, and was in every way similar to that described in the cerebral meninges. At various places, especially, however, in the exudation over the medulla and the cervical cord, there were a number of gas-cysts. The gas-cysts of the spinal meninges varied from twenty  $\mu$  to four to five mm. in diameter. The cysts of the pons and medulla did not exceed one hundred  $\mu$  in diameter. These cysts were round or oval in outline and contained, both in their cavities

and along their margins, a number of large bacilli. The exudate in the neighborhood of the cysts was usually compressed.

*Brain.*—Sections made through the abscesses in the supra-marginal and ascending parietal convolutions and including the intra-parietal tissue, and through the abscess of the superior temporo-sphenoidal convolution showed large central areas of necrotic material. This material was homogeneous and hyaline in appearance and stained diffusely with eosin. Here and there a few nuclei could be made out. Nuclear fragments were numerous in some places. In this material myriads of bacilli were found. The bacilli occurred singly and in small and large groups. About the necrotic area there was always a deep zone of dense cellular infiltration. The most numerous cells were polymorphous nuclear leucocytes. Lymphocytes and plasma cells were found in great numbers. Many of the cells resembling plasma cells contained two nuclei and were evidently proliferating. In some places cells with kidney-shaped nuclei were seen. This zone of cellular infiltration varied from one to three or four mm. in thickness. Bacilli in small and large groups, sometimes in huge clumps, could always be found in this zone. Infrequently bacilli were found in leucocytes. The blood-vessels near this zone were dilated. In many of the arteries among the red-blood cells many polymorphous nuclear and large mononuclear cells were seen. In some vessels thrombi were found. In these the intima cells were often desquamated and leucocytes were seen in the media. Well-marked cellular infiltration was found about many of the arteries. Bacilli were but rarely seen inside the vessels. Near the zone of cellular infiltration a varying number of bacilli were sometimes noticed. In rare instances in this region small spaces (gas-cysts), varying from ten to thirty  $\mu$  in diameter and containing bacilli, were found.

In sections including the wall of the left lateral ventricle no trace of the ependyma remained. The ventricular surface of the sections was covered with a thick layer of hyaline material staining diffusely with eosin. This hyaline, homogeneous layer varied in thickness, and was similar in appearance to the necrotic material of the abscesses of the cortex. This layer contained myriads of bacilli and often nuclear fragments, with an occasional polymorphous nuclear leucocyte. Beneath this layer there was a thick zone of cellular infiltration in every way similar to that described in the abscesses. Many bacilli were seen among the cells in this zone. The underlying tissue showed areas of infiltration with cells about the blood-vessels, many of which contained thrombi. With the exception of the gas-cysts and the inflammatory lesions above described, no special changes were made out in the white or gray matter of the brain or cord.

Sections of the gas-cysts or cavities in the internal capsule and in the lenticular nucleus showed simply separation and compression of the tissues due to the pressure exerted by the gas. None of the cysts appeared to be dilated blood-vessels. Large numbers of bacilli were always found along the walls of the cysts. In some places large clumps or colonies were to be seen. There was no inflammatory reaction about the cysts.

Four varieties of gas-cysts could be recognized in the central nervous system in this case. (1) Cysts developed in

the meningeal exudation on the surface of the cerebrum, cerebellum, pons, medulla and spinal cord. These cysts varied from twenty  $\mu$  to from two to five mm. in diameter. (2) Small cysts, never exceeding fifty  $\mu$  in diameter, occurring in the inflammatory exudation following the course of the arteries in the cerebellum. (3) Small cysts from ten to twenty  $\mu$  in diameter, occurring near the abscesses in the parietal lobes. (4) Cysts varying from 0.5 to 1.5 mm. in diameter found in the superior temporo-sphenoidal lobe, in the lenticular nucleus and internal capsule on the left side.

*Lungs.*—Sections of the lungs showed slight chronic interstitial pneumonia and emphysema. There was marked congestion of the air vesicles about some of the small bronchi. No bacilli were seen in the alveoli or in the blood-vessels, though some of the latter contained many leucocytes.

*Liver.*—The liver showed extensive fatty degeneration, best marked in the liver cells at the periphery of the lobules. The interlobular fibrous tissue was increased, and in many places was infiltrated with cells resembling lymphocytes and plasma cells. Nuclear figures were occasionally seen in the latter cells. The veins and capillaries were congested and in many bacilli were seen. In a number of sections there were areas varying from 0.5 to 1 mm. in diameter, in which the nuclei of the liver cells did not stain. The cytoplasm was swollen and more granular than ordinarily. Many cells contained fat drops. Many of the liver cells, especially in the centre of the areas, were shrunken to one-half their normal size. In these areas the endothelial cells of the capillary walls did not stain. Occasionally leucocytes still retaining their staining properties were seen. Long stout bacilli were always found, sometimes in small, but usually in great, numbers. Small gas-cysts containing bacilli were occasionally seen. The necrotic areas bore no special relation to the central veins, the portal veins or the bile-ducts. The latter were normal. The liver tissue in general was well preserved and stained well with the usual dyes.

*Spleen.*—The spleen showed marked congestion, but no areas of cell destruction and no gas-cysts.

*Kidneys.*—The kidneys showed cloudy swelling of the epithelium of the convoluted tubules, congestion of the glomerular and intralobular capillaries, and of the veins. No bacilli and no gas cavities were found. The heart showed nothing of interest.

The bacilli noted in the sections of the various organs were identical. They were most numerous in the brain abscesses and in the meningeal exudation. The bacilli varied considerably in size. They were sometimes two  $\mu$  long, but the most common forms were from four to six  $\mu$  in length. A few bacilli were seven  $\mu$  long. Some of the bacilli had square ends, but usually the ends were rounded. They often occurred in pairs, threes and fours, end to end. Not infrequently they were bent or curved, and some were wavy in outline. The bacilli stained well and uniformly with hæmatoxylin, thionin, methylene-blue and by Weigert's method. The last method gave the most clear-cut pictures. With this stain the outlines of the bacilli were often somewhat irregular, due to irregular swelling or contraction of their protoplasm. Slightly clubbed forms were sometimes seen. No stained capsules



were found in the tissues, but occasionally ill-defined masses resembling empty capsules were seen. Careful search of the affected tissues failed to disclose the presence of any other bacteria.

In this case it is evident that the tissue necrosis, the inflammatory lesions and the gas-cysts were due to infection by the bacillus aerogenes capsulatus. The pyogenic properties of this bacillus are now well known.

In my opinion the presence of the bacilli in such great numbers in the nervous system and their relative paucity in the blood-vessels and other organs precludes the idea that they were post-mortem invaders. When an unusual organism is found in association with inflammatory lesions it is no longer thought necessary to assume that the pyogenic cocci have caused the lesions and died out before the case came to bacteriological examination, thus reducing an organism found

in large numbers and in pure culture to the level of an accidental and innocuous invader. The complete revolution of our views concerning the pyogenic properties of the typhoid bacillus is an illustration in point. The formation of gas-cysts in the brain, the cerebro-spinal exudation, and in the liver is probably to be regarded as a post-mortem change. The perineal wound must be regarded as the portal of entry for the bacilli. A search of the literature fails to disclose a case of abscess of the brain with cerebro-spinal meningitis due to the bacillus aerogenes capsulatus. I have found this bacillus in the blood-vessels of the brain in several cases without inflammatory lesions. Through the courtesy of Dr. Reuling, I have examined a section through a gas-cyst of the brain of the case he reports in this number of the BULLETIN. In every respect it agrees in appearance with gas-cysts of the internal capsule and lenticular nucleus of my case.

## PROCEEDINGS OF SOCIETIES.

### THE JOHNS HOPKINS HOSPITAL MEDICAL SOCIETY.

#### Resistance to Quinine of Certain Forms of Malaria.—Dr. CAMAC.

The value of the following temperature records is both diagnostic and therapeutic. Where the aid of the microscope is not to be had the temperature chart may be all the physician has to guide him in both diagnosis and treatment. It is with the object of drawing conclusion on these two heads that the present malarial temperature charts are exhibited. In each of the following cases the malarial parasite was, of course, found and its type determined, so that the conclusions are reliable as referring to malaria only.

CASE I.—J. B. TYPE ÆSTIVO-AUTUMNAL. *Blood Examination by Dr. Hamburger.* Sept. 30 (day of admission), intracellular hyaline amœboid ring-shaped bodies; one crescent. Oct. 1, a crescent; organisms scarce; hyaline intracellular body. Oct. 2, 10 a. m., quinine gr. x; 12 m., quinine gr. v q, 4h.; p. m., one intracellular hyaline body. Oct. 3, No organisms.

*Temperature.*—Daily paroxysm; not reaching normal during the intervals; temp. normal on Oct. 4.

*Treatment.*—70 grains of quinine required to control fever. Time required, 3 days.

CASE II.—R. B. (colored). TYPE ÆSTIVO-AUTUMNAL. *Blood examination by Dr. Pancoast.* Sept. 24 (day of admission), 7 p. m., one ring-shaped body. Sept. 25, 10 a. m., ring-shaped amœboid body. 12 m. quin. gr. x; 4 p. m., quin. gr. v q, 4 h.

*Temperature.*—Daily parox.; slight drops, not reaching the normal (Widal's agglutination negative); temp. normal 27th.

*Treatment.*—95 grs. required to control fever—3 days.

CASE III.—M. J. TYPE ÆSTIVO-AUTUMNAL? *Blood examination by Dr. Pancoast.* Sept. 27 (day of admission), one ring-shaped body; 10 p. m., quinine gr. x; 12 m., quinine gr. v q, 4 h.

*Temperature.*—Daily paroxysms; not reaching normal during intervals. 2 p. m., 27th, temp. 104.2; fever apparently controlled by quin.; parox. only delayed. 10 p. m., 29th, temp. 101.8. 10 p. m., 30th, temp. normal.

*Treatment.*—105 grs. required to control fever; time required, 3 days. Especially instructive case as blood examination was not conclusive.

CASE IV.—P. C. TYPE DOUBLE TERTIAN. *Blood examination by Dr. Hunner.* Numerous organisms. 2 sets, 1st full grown in very pale corpus; fine, actively motile pigment; 2d, half-grown intracellular pigment, motile; corpus somewhat enlarged.

*Temperature.*—Parox. 27th, from 2 p. m. to 3 p. m. Parox. 28th, 2 p. m. Quin. gr. xx, 2 p. m.; quin. gr. v, 6 p. m. q. 4 h.

*Treatment.*—50 grains controlled fever, inclusive of time when parox. should have occurred. Time required, ½ day.

CASE V.—J. S. TYPE DOUBLE TERTIAN. *Blood examination by Dr. Hunner.* Two sets of organisms: 1st group, Sept. 13, parox. 2 p. m.; 2d group, Sept. 14, parox. 6 p. m.; 1st group, Sept. 15, parox. 2 p. m.; 2d group, Sept. 16, parox. 4 p. m.

*Treatment.*—Sept. 16, 4 p. m., subcutaneous inject. quin. gr. xviii. Sept. 17, parox. of 1st set delayed to 6 p. m.; also modified Sept. 15, 104.8; Sept. 17, 102.6. Sept. 17, 6 p. m., intravenous inject. gr. vii ss. Sept. 17, abortive rise at 10 p. m. Sept. 18, fever controlled. Fever controlled by 25½ grs. Time required, 2 days.

CASE VI.—J. B. TYPE DOUBLE QUARTAN. *Blood examination by Dr. Cushing.* Two sets of quartan parasites. Case developed on surgical side. Further blood examination made by Dr. Thayer. Oct. 26, 10 p. m., paroxysms complete; quin. grs. v, 2 and 4 p. m. Oct. 28, 2 a. m., paroxysms complete. Oct. 29, 12 noon, quin. grs. v q, 4h. Oct. 30, slight parox. Oct. 31, slight parox.

*Treatment.*—30 grs. greatly modified parox. of two group; 75 grs. controlled fever.

There are to be observed in these six cases several striking features: 1st, The marked resistance to quinine of the æstivo-autumnal type. 2d, The tendency of the æstivo-autumnal not to reach normal during the intervals. 3d, No form resisting the quinine beyond 3 days.

The most effectual time to exhibit quinine has been fully investigated by Golgi; Marchiafava and Bignami, and Case VI of the present series demonstrates well Golgi's observations. He finds that quinine administered in quartan fever, 4 or 5 hours (even in small doses) before segmentation readily kills the young forms, but has no influence upon the adult forms, the following paroxysms occurring uninterruptedly. The tertian, however, is readily influenced by the administration of quinine just before the paroxysms (Case IV), the following paroxysms being prevented or delayed. From the teachings of Marchiafava and Bignami the following may be concluded for tertian and quartan fever:



- Full dose at crisis :      ( 1. Parox. prevented.  
                                     2. Aborted.  
                                     3. Delayed 6-24 hours.
- Full dose 6 hours before crisis :      ( 1. Delayed.  
                                     2. Aborted.  
                                     3. Pseudocrisis.

By watching the chart and observing first its character uninfluenced by quinine, then its character after the administration of quinine, and noting at the same time when the quinine was administered with reference to the paroxysm, the diagnosis not only of malaria but of its type may sometimes be made. Fever which shows no signs of breaking three days after the administration of full doses of quinine every four hours is other than malaria; if it yields earlier than the third day, on moderate doses, it is likely to be of the tertian or quartan type, whether double or single. The tendency of the æstivo-autumnal fever to resist quinine has led the Italian observers to speak of the gradual destruction of the parasite as one of "fractional sterilization," and this tendency would induce the careful physician to prolong his quinine for a greater period in dealing with this form. Here, however, we may take as a guide the fact that the æstivo-autumnal fever often fails to touch normal during the intervals between paroxysms, whereas the tertian and quartan more commonly do. To those cases therefore who bear quinine badly it may be discontinued earlier and with greater safety in the tertian and quartan than in the æstivo-autumnal.

It may, however, with profit, be repeated, and repeated emphatically, that fever which does not show signs of *breaking* within three days, when properly met by quinine, is other than malarial, and quinine is being given not only to no advantage, but in many cases with harmful effects.

We have, therefore, in the proper observation of the temperature chart, both a diagnostic and therapeutic guide, though we have not the aid of the microscope.

It may be interesting in this connection to mention a recent conversation with Dr. John T. Metcalfe, one of Louis' students, who remembers the pre-quinine days. I think it was about 1820 that quinine was separated by Pelletier, prior to which Peruvian bark was used exclusively. The preparation known as Peruvian paste was so thick that it could be just swallowed. A tablespoonful was taken at a dose, and frequently vomiting was so severe as to require the use of opium. A 3-ounce bottle of quinine was brought to Natchez, Miss., and was sold for \$90.

#### A New Method of Staining Malarial Parasites. - Dr. FLETCHER.

As Dr. Lazear and myself, during the past winter, came across a convenient method of staining malarial parasites in dry specimens, I thought it might be of interest to report it to the society. We do not claim originality, either for the method of fixing, or the method of staining, the organisms, but, so far as the combining of the two methods is concerned, we think it has not been done before. It is a very quick process and very serviceable in cases where one is called out to see a suspicious case and has not a microscope at hand with which to examine the fresh blood.

The dried-blood specimens, made in the usual way described by Ehrlich, are then fixed in a  $\frac{1}{4}$  per cent. solution of formalin in 95 per cent. alcohol. It is important that the formalin

solution should be made up fresh each time it is used. We have found satisfactory results by adding four or five drops of a ten per cent. aqueous solution of formalin to 10 cc. of 95 per cent. alcohol just before using. This method was first described by Benario in the *Deutsche Medicinische Wochenschr.*, No. 27, 1894. He used a 1 per cent. solution of formalin in 90 per cent. alcohol, however. He stated that not only was the hæmoglobin of the red cells well preserved, but the granules and nuclei of the leucocytes were well fixed and took the stain particularly well. The cells were especially well stained with eosin and hematoxylin. The specimens are fixed in this solution for only one minute, washed in water, blotted and then stained in the special mixture.

As to the staining agent, our attention was first drawn to the use of thionin by Dr. W. G. McCallum, who referred us to an article by E. Marchoux, in the *Annales de l'Institut Pasteur*, Vol. ii, p. 640, 1897, in which the author gives a report on the malarial fevers of Senegal, and in which he describes his method of using thionin in staining the parasites. The author considered it especially serviceable for staining malarial organisms, but instead of formalin he used the ordinary alcohol and ether fixing method and, so far as we know, the use of formalin and this stain have not been combined before. He makes a saturated solution of thionin in 50 per cent. alcohol, of which 20 cc. are added to 100 cc. of a 2 per cent. carbolic acid solution. This solution can be kept in stock and used as required. It is perhaps better to keep the stain for some time before using as it improves with age. Thionin phenate is formed, which is believed to be the active staining agent. Only 10 to 15 seconds are required for staining.

The malarial parasites come out very distinctly as reddish-violet bodies with this stain, and it is especially serviceable in staining the ring-shaped bodies of the æstivo-autumnal infection. These are very hard to distinguish in fresh specimens and usually do not stain satisfactorily with eosin and methylene-blue. Any one who has stained specimens in this way knows how he has regretted, on examining them two or three months later, to find that they have faded. With the thionin stain the parasites retain the color much better than they do when stained with methylene-blue.

The method of fixing and staining malarial parasites is then as follows:

Make the ordinary smear preparation, fix in the formalin solution for one minute, wash in water, thoroughly dry, stain with the thionin solution for from ten to fifteen seconds; ten will probably give the most satisfactory results. Wash off the excess of stain, blot, mount in balsam and the specimen is ready to be examined. The whole operation does not last more than two minutes from the time you begin to fix until it is ready for examination, whereas with the old method of fixing with alcohol and ether, one usually has to wait two hours to get satisfactory results, and even then it is often found, if eosin and methylene-blue have been used, that the hæmoglobin of the red cells has not been properly fixed and the cells show peculiar vacuolic areas. With the formalin fixing and thionin staining the protoplasm of the reds is well fixed and practically unstained, and the parasites stand out

distinctly as reddish-violet bodies in the substance of the red cell. The ring-shaped bodies of the æstivo-autumnal variety come out much better than with any other agent in use.

We also used the thionin stain to try and bring out the flagellated processes in the æstivo-autumnal infection. Probably one of the most convenient methods for obtaining permanent preparations of the flagella is that described by Sakharov, in which an ordinary specimen on the slide is made and at the same time several specimens of blood are taken on coverslips, leaving the latter in contact with each other in a moist chamber and watching the ordinary preparation under the microscope until flagellation begins, when the coverslips in the moist chamber are taken out and drawn apart and dried. One will then most likely catch the organisms in the flagellating stage. We have fixed some of these by heat and then stained with thionin, and have obtained some good specimens showing the flagellate processes coming off from the body of the parasite. At this time we had not been using the formalin fixing, but there is no reason why it should not be substituted for the heat.

This method of fixing and staining is not to supersede the examination of the specimen of fresh blood, always the most satisfactory method, but only where staining is the only resource and rapid results are desired. We have placed under the microscope on the table specimens of the three types of malarial organism stained by this method.

Dr. FLEXNER.—There is a method, you will remember, which was worked out by Dr. Mallory for staining the *ameba coli*. The specimen is stained in thionin and placed in a weak solution of oxalic acid to remove the coloring matter from all other cells except the *ameba*. I also had the opportunity of studying recently some specimens of *amebic dysentery* stained by Dr. Harris of Philadelphia, with toluidin blue and the organisms are as easily made out as when stained with thionin. I do not know whether these methods would succeed with the malarial parasite, but they might be tried.

Dr. LAZEAR.—During the summer I tried the toluidin blue for the malarial parasite. It is fully as good as methylene-blue, but does not stain so deeply as the thionin.

Dr. THAYER.—It appears to me that the method of staining advised by Dr. Fletcher is one which is of very considerable practical value. It is often impossible for the busy practitioner to examine the fresh specimen of blood, and most of the other methods of preparation are rather delicate proceedings, at least if one wishes to obtain really good specimens. A thoroughly satisfactory method which can be carried out almost inside of two minutes is a great advance.

I should like to emphasize particularly its value in staining the æstivo-autumnal parasites. The hyaline bodies take up all dyes very feebly, and it is often extremely difficult for the unskilled eye to distinguish them. By Dr. Fletcher's method of staining with thionin, however, a perfectly satisfactory specimen may instantly be obtained. I know of no method which brings out the æstivo-autumnal parasite so well.

#### Laparotomy for Intestinal Perforation in Typhoid Fever. [See BULLETIN for November Discussion, 1898.]

Dr. THAYER.—I had the good fortune to observe the first case which Dr. Cushing has mentioned throughout the greater part of its course. I happened to walk into the ward on the night upon which the second operation was done and found the boy in a condition of profound collapse. This had come on very suddenly, Dr. Cushing having seen the child but a short time before. When I saw him he had been vomiting; the skin was cool; there was profuse sweating; the temperature had fallen several degrees; there was abdominal tenderness; the pulse was feeble and rapid; the face was drawn; the cheeks and eyes sunken. There could scarcely have been a more typical picture of acute peritonitis. And yet, when the abdomen was opened, there was not only no peritonitis, but there was not enough disturbance to suggest the existence of obstruction to any one present. Such a picture is an excellent demonstration of the difficulties which may stand in the way of a correct diagnosis in these cases.

What Dr. Cushing has said of the leucocytes is, it seems to me, of considerable importance. I have no doubt that it is quite true that in an individual with distinct evidences of perforative peritonitis a normal or subnormal number of leucocytes is a very bad prognostic sign. I remember one or two instances of general streptococcus septicæmia where the leucocytes were normal or subnormal in number; one case in particular where there were but 3000 leucocytes to the cubic millimeter. As long ago as 1892, Werigo showed that after inoculating animals with cultures of pyogenic bacteria there occurs primarily a reduction in the number of leucocytes to the cubic millimeter. In the milder cases this initial fall is followed by a subsequent leucocytosis. In the particularly malignant and rapidly fatal cases, however, no subsequent rise in the number of leucocytes occurs. The same condition has been noted experimentally by various other observers. And I am inclined to believe that, as in pneumonia, so in other malignant general infections, a subnormal number of leucocytes may be regarded as a bad symptom, and it is not at all impossible that in Case III the fall in the number of leucocytes following the direct evidence of perforation may well have been associated with the sudden onset of what proved to be a rapidly fatal streptococcal infection, the previous leucocytosis having been due to the moderate local peritonitis about deep ulcers.

Monday, December 19, 1898.

#### Presentation of Pathological Specimens. Drs. MACCALLUM and HARRIS.

Dr. MACCALLUM presented a case exhibiting multiple metastases from a sarcoma primary in the pelvis. The patient was a young man, aged 21, who had complained of chills and obstinate constipation with great pain on defecation. There was also severe pain in knee, hip and back, and recently considerable loss in weight and strength. Physical examination revealed signs of consolidation at left apex; tumor masses projecting laterally out of the pelvis in the inguinal regions; and per rectum a large smooth mass filling the pelvis over which the mucosa of the rectum could be



moved. There were also several subcutaneous nodules. After a very painful illness the patient developed a pleurisy and died without any great elevation of temperature.

At the autopsy the most extensive tumor growth was found in the pelvis. The pelvis was completely choked by the new growth which projected over its brim and formed the nodules palpated during life. The mass lay between the bladder and intestine, projecting into the bladder and forming a large ridge across its posterior wall. The prostate retained almost its normal appearance, the median lobe being apparently unchanged. Rectal mucosa was not involved. This large tumor was directly continuous with the chain of retroperitoneal glands which were densely matted together and surrounded the recto-vesical cul-de-sac. Sections showed that the tumor—an alveolar large round-cell sarcoma with giant cells—had invaded the bladder from without, as remains of epithelium exist over the intra-vesical projection. The prostate was almost completely replaced by the tumor mass, and the seminal vesicles pushed far back towards the rectum. Metastases occurred in the testes, liver, epicardium, lungs and mesentery, as well as the subcutaneous tissues. The lymphatic glands, with the exception of the immediately adjacent retroperitoneal glands, were very slightly involved.

In the lung, in addition to a mass at the hilum, the metastases were chiefly in the form of flat, button-like nodules on the pleural surface, and on cutting up the arteries which run to these nodules, the arterial walls were seen to be infiltrated with tumor cells so as to form a thick cord-like structure with relatively narrow lumen—a few of these arteries were actually plugged with masses of tumor cells, evidently indicating the channel of metastasis. The possibility, perhaps, cannot be excluded that the perivascular involvements in the neighborhood of the subpleural nodules are merely extensions in the lymphatics of the vessels from the tumor masses which themselves may have arisen from an infection of the pleura—an idea supported by the extensive involvement of the costal pleura.

The very similar cases of Andree and Zenker (both reported in Virchow's Archiv) were referred to.

Dr. HARRIS.—The greater interest of this case, no doubt, lies in the pathological statement that Dr. MacCallum has presented, but the bacteriological findings will, I think, prove by no means unworthy of consideration.

The bacteriological analysis of the autopsy was as follows: The streptococcus pyogenes was isolated in pure culture from the liver, the spleen and a sarcomatous nodule on the abdominal wall; associated with this organism was the bacillus proteus vulgaris in a culture obtained from the lung.

Subsequently, additional interest was added to the case by the accidental infection with the streptococcus of Dr. Cushing and Miss Reed. In the former, the symptoms of beginning trouble appeared within six hours at the site of a small prick in one finger; within twelve hours the axillary glands and lymphatics of the limb were swollen and tender. The symptoms of infection becoming more pronounced, surgical aid was required, and, with excision of the infected area, recovery

soon set in. From the excised portion of the finger the streptococcus pyogenes was obtained in pure culture.

In the latter case of infection the trouble was entirely local in character, being confined to the tissues at the root of a finger-nail. Redness, pain, swelling and pus formation were the cardinal symptoms. The finger received surgical treatment and slowly healed by granulation. Coverslips from pus showed streptococcus. In consideration of these two cases of accidental infection it was thought advisable to continue the bacteriological study of the organism, and tests were made to determine its virulency upon mice. The first mouse received subcutaneously 0.3 cc. of a bouillon culture. It was found dead next morning, and had probably died within twelve hours—rather a rapid result. The animal was autopsied, but all that was found was a subcutaneous edema with possibly a small focus of necrosis. The inguinal glands were swollen, but not hemorrhagic. The axillary glands were in the same condition, and all the vessels leading to them were tremendously engorged. The lumbar and mesenteric glands were increased in size. The spleen was greatly swollen, dark-red and soft; the liver was also enlarged and friable; the kidneys in the same state, but pale instead of dark. Cultures from the organs of the mouse were negative, the organism being recovered only from the site of inoculation.

From that organism the second mouse was inoculated, using only one small loopful from the agar culture and administered beneath the skin. This mouse died in sixty-five hours, and the same appearances were found on autopsy of this animal. In addition the lungs showed numerous broncho-pneumonic patches. From these and from the heart's blood the organism was obtained in abundance.

From a liver culture of this mouse a third mouse was given the same quantity, and it died in less than sixty hours.

Upon the grounds of susceptibility to infection with the streptococcus pyogenes we are at once struck by the fact that the human being is very much more prone to this infection than mice, for, in a large number of cases occurring in the human subject, the isolated organism fails to kill a mouse inoculated with it. I can call to mind several occasions where I injected rabbits and mice with streptococcus obtained from cases of puerperal septicæmia, and had entirely negative results. Therefore, upon the high degree of virulence exhibited by this streptococcus, is the bacteriological side of the case presented.

#### NOTES ON NEW BOOKS.

Twenty-ninth Annual Report of the Massachusetts State Board of Health. (Boston: Wright & Potter Printing Co., 1898.)

The Massachusetts State Board of Health Report for 1897 contains the records of work done by the Board during the year set forth in the lucid style so long characteristic of preceding issues. A general report, including a joint report upon the restoration of Green Harbor, is followed by a section relating to water-supply and sewerage. This section contains a report to the legislature, advice to cities and towns regarding their respective water-supplies and sewerage systems, records of chemical and microscopical work done in the examination of water-supplies and rivers, water-supply statistics and a complete account of the work at the Lawrence Experiment Station on sewage purification and the filtration of



water. The sewage purification of cities and towns in Massachusetts is finally discussed.

Section 3 consists of a report on food and drug inspection and the analytical examination for adulterations, etc.

Sections 4, 5, 6 and 7 describe the work and results of the State Bacteriological Laboratory, including diagnostic examinations and the making of antitoxin.

Statistical summaries of disease and mortality follow, and a review of the sanitary statistics of the various towns of the commonwealth completes the report.

There is, perhaps, no publication in this country in which statistics are more carefully worked out, or made to yield more definite information, than those collected by the Massachusetts State Board of Health, largely due to the fact that its well-known secretary is one of the most careful and patient statisticians in this country.

From this report, we gather that infectious diseases in Massachusetts have steadily decreased during the last forty years, with the exception of a slight rise in 1896. An outbreak of small-pox, limited to about eighteen cases, occurred in Boston and neighboring municipalities during the first half of the year. In this connection, and in view of the recent retrograde changes in the vaccination laws of England, it is interesting to note that during the ten years (1888-1897) the death-rate in Massachusetts amongst vaccinated small-pox patients was 6.3 per cent., and amongst unvaccinated small-pox patients 25.5 per cent., about four times greater. We may note here that in Massachusetts, also, the vaccination laws suffered, in 1894, an unnecessary amendment, still in force, allowing any regular physician to certify to the unfitness of a child for vaccination, so exempting the child from the legal restrictions otherwise imposed. The granting of such exemptions should certainly be left to the discretion of boards of health.

Typhoid fever showed a reduction of about twelve per cent. Careful consideration of the mortality lists of the different Massachusetts towns confirms once more the rule that a continued high death-rate from this disease in any one community points to the probable pollution of the water-supply of that community and calls for careful investigation. The number of diphtheria cases steadily decreased during the years 1894, 1895 and 1896. The fatality of cases diminished in a much greater ratio due probably to improved treatment and greater sanitary precautions. It can be definitely established that the fatality of epidemics, as well as their extent, is generally lessened by rigid supervision and painstaking care.

The epidemic of cerebro-spinal meningitis, which occurred early in this year (1897), has been exhaustively treated in the monograph of Councilman, Mallory and Wright, to whom the investigation of the epidemic was entrusted by the State Board of Health. This monograph is abstracted in the report. It is interesting to compare with this epidemic of the year 1897 in Boston, the similar epidemic in Chicago during the year 1898, an account of which has been recently issued by the Chicago Health Department.

The food and drug inspection and examination upset some of the popular notions regarding the supposed extensive adulteration of foods. The adulterations in most cases are usually of a nature commercially fraudulent rather than physiologically harmful. It is curious to note that the production of pure butter is provided for by the maintenance of no less than four separate sets of *officers*, while on the other hand, the laws supposed to control the sale of poisons allow the unlimited sale of proprietary medicines containing violent irritating poisons or narcotics, a defect certainly requiring correction.

In most of the large cities of the State, bacteriological laboratories have been established for the diagnosis of diphtheria, tuberculosis, malaria, etc. The bacteriological laboratory of the State Board, in addition to the production of diphtheria and tetanus antitoxin, undertakes diagnostic work for those communities unprovided with a local laboratory. The use of formaldehyde as a gaseous disinfectant has become quite general throughout the State.

A large part of the report deals, as usual, with the analysis of the public water-supplies of the State, and also of rivers not now used for water-supply but receiving sewage from communities on their banks, a very provident proceeding; also with the investigations of the Lawrence Experiment Station on the filtration of water and disposal of sewage. In January, 1897, the laboratory for water analysis was transferred from the rooms of the Institute of Technology to the State House. Both this laboratory and that of the Experiment Station at Lawrence are now under the charge of Mr. H. W. Clarke. The chemical and microscopic methods developed in these laboratories continue in use. The bacteriological work is restricted to the usual efficiency tests of the filters and examination of Merrimac river water at the Experiment Station. No record of bacteriological work on the other public water-supplies is given. Owing to the distance which many of the samples of water must travel to reach the laboratory, and to the difficulty and expense of providing cold storage in transit for them, we think it probable that the additional information which may be obtained by bacteriological analysis of the water-supplies of the whole State is likely always to be restricted to qualitative work, omitting the quantitative as impracticable. Nevertheless, so many interesting and valuable chemical and biological determinations embracing not only the mere analytical results, but also the methods of analysis themselves, have come from the laboratories of the State Board in the past, that one is tempted to hope the near future may see quantitative bacteriological methods employed, for a time at least, on all the water-supplies of Massachusetts, if only to demonstrate their practicability or impracticability, in such work as the Board undertakes for the public. We think that the value of such bacteriological work is considerable and its practicability has been already amply demonstrated, certainly where the laboratory can be reached within a few hours of the collection of samples. The Lawrence experiments this year (1897) have been devoted to a continuation of the experiments of last year (1896) on the purification of tannery, paper-mill and wool-scouring establishments, on the filtration of highly polluted waters, and on the removal of iron from the waters of certain parts of the State.

Under food and drug inspection, and in addition to the ordinary routine work, the foil used for wrapping various preparations, the metal stoppers of liquid preparations, etc., have been examined for lead with interesting results. In certain countries, the inspections of these wrappers and stoppers as well as of culinary utensils, beer faucets, etc., is controlled by law. The refractometer, principally, is used in the detection of adulteration of such fats as butter, lard, olive oil, etc. A large percentage of cheap jellies were found to contain no trace of the raspberry, strawberry, etc., which the label proclaimed as present.

The report of the bacteriological laboratory of the Board at the Bussey Institute, under the charge of Dr. Theobald Smith, contains a number of tables illustrative of the results of the use of antitoxin, classification of the bacteriological diagnoses made and of the examinations for the malarial organisms.

Under the *Health of Towns*, an epitome of the reports of the various boards of health of the State is given. The action of the Lowell authorities in attaching a "poison" label to all the faucets in the mill fed with canal water shows that they at least are troubled with few doubts on the dangers of polluted water-supplies.

In conclusion, we may congratulate the State Board of Health, through its president, Dr. Walcott, on the continued excellence of its Annual Report as exemplified in this issue. It must be confessed that we miss the detailed accounts of methods of water analysis, their applications and limitations, which have made certain of the previous reports indispensable adjuncts to chemical, biological and bacteriological laboratories throughout this country. No one institution has contributed more to these subjects in the past; certainly no one of these subjects is yet exhausted. We believe that much of the information bearing on these points is still practically unknown in many sections of the country. Nor can we do other-

wise than regret that the able pen of Dr. Smith has not yielded to this report some account of the routine methods in his department. Changes in technique, however slight, are often of considerable value, and in any case, the repeated publication of even an unchanging routine, wearisome as it may seem, gradually tends to bring about a greater uniformity in method as new laboratories are established and the latest and most successful methods are considered for adoption. To the sanitarian and statistician, in general, the present volume will prove fully as interesting as its predecessors, but the student, the analyst and the ubiquitous "laboratory man" will certainly turn back, with some disappointment, to the reports of 90-96.

To the general public, the explanations accompanying some of the statistical tables of this report and the brief summaries of the conclusions to be deduced from the tables are most valuable. We can only wish that this method of making clear to "the laity" the meaning of the endless succession of figures in which statisticians delight was more extended in this report and more generally followed in others of a similar nature. H. W. H.

**A Primer of Psychology and Mental Disease.** For use in Training Schools for Attendants and Nurses, and for Medical Classes. By C. B. BURR, M. D., Medical Director of Oak Grove Hospital, &c. Second Edition. Thoroughly Revised. (The F. A. Davis Co., Philadelphia, New York, Chicago, 1898.)

The appearance of a second edition of Dr. Burr's *Primer of Psychology* is, in itself, evidence that it has met a want and, considering that there are other more or less similar works to compete with it in its rather limited circle of patronage, is an indication of its worth. The present edition, in addition to the general revision, has had added an address given before the Training School class of the Eastern Michigan Asylum, in 1895, a valedictory address on the occasion of his leaving that institution.

If one is to offer any criticism of the work it would be on some minor point, such as, for example, the statement that in mania there is no tendency to suicide. Maniacs do sometimes commit impulsive suicide, and like most other insane are to be considered as rather uncertain in their conduct and needing watching. This and possibly one or two other similar statements should be less absolute, and in a future edition their modification is suggested. As a treatise for the instruction of hospital attendants we can heartily recommend this book.

**Archives of the Roentgen Ray.** Edited by W. S. HEDLEY, M. D., and SIDNEY ROWLAND, M. A. Vol. II, No. 4; Vol. III, No. 1. (W. B. Saunders, Philadelphia, 1898.)

These two issues of this now well-known publication appear to be fully equal to their predecessors, and to contain the usual number of scientific communications. Most of them are of a rather technical character, relating to the physical characteristics of the X-Rays and their management, as would be naturally expected, but one or two are of medical interest. One of these is the preliminary notes of Drs. Wolfenden and Ross on the influence of the Roentgen Rays upon the growth and activity of bacteria and micro-organisms, in which they were found to have a very marked stimulating influence on the bacillus prodigiosus. The authors are continuing their research on the pathogenic bacilli especially, and it will be an important gain if they can give us some authoritative data on their behavior under the action of the rays.

The same issue reproduces from the *British Medical Journal* an abstract of the papers and discussions on the uses of the Roentgen Rays in the diagnosis of tuberculosis at the late congress on this disease at Paris last summer. Their value, in this particular direction, seems fairly settled, or at least highly probable, when they are utilized by experienced operators.

**On Cardiac Failure and its Treatment.** With special reference to the use of baths and exercises. By ALEXANDER MORISON, M. D., Edin., M. R. C. P., Ed. (London: The Rebmman Publishing Co., Ltd., 1897.)

This work is a scientific monograph on cardiac weakness, a condition that is sometimes too little recognized, though, unfortunately frequent enough and often of serious importance, even without actual irreparable organic disease affecting the mechanical action of the heart. Whether it be the nervous system that is at fault, or the muscular tissue has lost its tone, or the heart is embarrassed by the mal-coöperation of other important organs or tissues, the general result is alike in all, a cardiac failure, varying only in degree in any particular case. The recognition and treatment of each and all of these factors is an important question, and serves to indicate how complete in this, as in other affections, the investigation of the disorder should be from the very beginning of the treatment.

The book appears to give within its compass reliable and thorough monographs of its subject, and the latter portion on the treatment of these conditions will be doubtless found valuable and suggestive. The remarks upon and descriptions of the gymnastic and hydrotherapeutic methods ought to be particularly useful as comparatively new in our literature, and the author has supplemented his own skilled observations and opinions with an appendix by Dr. Groedel, of Bad-Nauheim, who has also had the revision of the chapters on these special subjects.

## BOOKS RECEIVED.

**Archives of the Roentgen Ray.** Edited by Thomas Moore, F. R. C. S., and Ernest Payne, M. A. (Cantab.) Vol. III, No. 2, November, 1898. 4to. The Rebmman Publishing Co., London. W. B. Saunders, Philadelphia.

**Annual and Analytical Cyclopædia of Practical Medicine.** By Charles E. de M. Sajous, M. D., and one hundred associate editors, etc. Volume II, 1899. 4to, 607 pages. The F. A. Davis Co., Publishers, Philadelphia, New York and Chicago.

**The American Year-book of Medicine and Surgery.** Collected and arranged with critical editorial comments by S. W. Abbott, M. D., J. J. Abel, M. D., et al. Under the general editorial charge of George M. Gould, M. D. 1899. 4to, 1102 pages. W. B. Saunders, Philadelphia.

**Saint Thomas' Hospital Reports.** New series. Edited by Dr. Hector Mackenzie and Mr. G. H. Makins. Vol. XXVI. 1898. 4ro and 170 pages. J. & A. Churchill, London.

**3000 Questions on Medical Subjects Arranged for Self-Examination.** Second edition. 32°. 1899. 189 pages. P. Blakiston's Son & Co., Philadelphia.

**An American Text-book on Diseases of the Eye, Ear, Nose and Throat.** Edited by G. E. de Schweinitz, A. M., M. D., and B. Alex. Randall, M. A., M. D., Ph. D. 1899. 4to, 1251 pages. W. B. Saunders, Philadelphia.

**Saint Bartholomew's Hospital Reports.** Edited by N. Moore, M. D., and D'Arcy Power, F. R. C. S. Vol. 34. 1899. 8vo, 396 and 258 pages. Smith, Elder & Co., London.

**Thirty-fourth Annual Report of the Trustees of the Boston City Hospital, with report of the Superintendent, February 1, 1897, to January 31, 1898, inclusive.** 1898. 8vo, 215 pages. Municipal Printing Office, Boston.

**Transactions of the Medical Society of the State of North Carolina.** Forty-fifth annual meeting held at Charlotte, N. C., May 3, 4 and 5, 1898. 8vo., 173 and 50 pages. Carolina Publishing Co., Winston, N. C.

**Transactions of the American Ophthalmological Society.** Thirty-fourth annual meeting, New London, Conn. 1898. 8vo, 471 pages. Published by the Society, Hartford.

**Transactions of the College of Physicians of Philadelphia.** Third series. Volume the twentieth. 1898. 8vo, 227 pages. Printed for the College. Philadelphia.



# BULLETIN

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### ACUTE DIFFUSE GONOCOCCUS PERITONITIS.

By HARVEY W. CUSHING, M. D.

(From the Surgical Clinic of Dr. Halsted, The Johns Hopkins Hospital.)

Owing to the influence of Bumm's original assertion, that gonorrheal processes remain limited to surfaces lined by mucous membrane, it had until comparatively recent times, been generally doubted that the gonococcus of Neisser, without the association of the more common pyogenic organisms, was capable of inducing an acute general peritonitis. It is, however, now recognized that structures other than those of an epithelial character are liable to invasion by the gonococcus and, indeed, parts covered by endothelium seem particularly liable to attack by this organism. Thus the joints, plura, pericardium and endocardium are liable to gonococcal infection, and although these affections are metastatic in character, and occur during the course of a general gonococcus septicemia, they nevertheless suffice to prove the untenableness of Bumm's original statement. Nevertheless surgeons have clung to the belief in the immunity of the peritoneum to gonococcal infection, and it has generally been granted that gonorrheal processes in women are checked in the neighborhood of the abdominal ostia of the tubes, where by continuity of extension, a peritonitis otherwise might readily be induced. We must for the present continue to believe that such an inhibition of the growth of the

organisms does usually occur when the serosa is reached, but whether under unusual circumstances a general peritonitis may not follow, by implantation of gonococci from the tubes upon the peritoneum, has hitherto been regarded as extremely improbable. The usual conception is concisely expressed in a recent paragraph by Frederick Treves,\* as follows:

"Peritonitis has been met with in association with gonorrhoea, but inasmuch as the gonococcus cannot survive in the peritoneal cavity it is doubtful whether peritonitis due to the gonococcus alone has any existence. . . . It is very probable that a mixed infection is the cause of the pyosalpinx often met with in gonorrhoea. That pyosalpinx may lead to acute peritonitis is undoubted, but it has not been demonstrated that such a complication is due to the action of the gonococcus alone; it is probably the outcome of a mixed infection. . . ."

Even among those few investigators, who have devoted their attention from an experimental as well as a clinical standpoint to the possibility of this complication of gonorrhoea in

\* Fred'k Treves, Allbutt's System of Medicine. Vol. III. p. 669, 1897.



women, the subject remains one of debate for the want of one link in the chain of evidence, which it is hoped that this communication will establish.

The recent observation at the Johns Hopkins Hospital of two cases of diffuse peritonitis, due to pure gonococcal infection, which it is the design to report, has led to the following brief historical review of the literature dealing with the question outlined in the preceding paragraph.

Bumm,\* in 1889, published the following statement in which the principles laid down by most subsequent writers can be seen reflected. "Ab es eine gonorrhöische Entzündung des Peritoneum giebt ist mir immer sehr Zweifelhaft gewesen. Die Mikroben der Gonorrhöe vermögen nur auf Schleimhäuten pathogene Wirkungen zu entfalten, gehen aber in Serösen Höhlen zu Grunde. Reiner gonorrhöischer Eiter, der sich aus geplatzten Tubensäcken in's Peritoneum ergießt, wirkt in der Regel nun als aseptischer Fremdkörper. Es wird abgekapselt, etc." He goes on to say that only a mixed gonococcal infection can be followed by a septic peritonitis.

At the meeting of the German Gynecological Society, held in Bonn, in 1891, Bumm† further emphasized his views. He believed that gonorrhöal infections ran a course as a superficial mucous membrane affection merely and never penetrated the deeper connective tissue in which the gonococcus would perish: that the organism of Neisser had nothing to do with septic processes, which occurred only through the medium of mixed infections: that the gonorrhöal process, usually localized in the urethra and cervix, under certain influences, primarily that of menstruation, but also during the puerperium, and from coition and instrumentation, might extend to the endometrium of the body and tubes. Beyond these parts, however, he believed the process did not pass, being limited by the endothelial peritoneal surface.

At this same meeting Wertheim‡ presented the results of some clinical and experimental investigations which question the assertion as to the immunity of the peritoneum in Bumm's sense, and which remain to-day the most important contribution to this subject.

His observations, which are directly in opposition to those of Bumm, demonstrated conclusively that at all events a *circumscribed* pure gonococcal peritonitis could be produced experimentally in animals and was possible in human beings.

\* Bumm, E. Zur Aetiologie der septischen Peritonitis. Münchener med. Wochenschr., Bd. XXXVI, No. 42, p. 715, 1889.

† Bumm. Ueber die Bedeutung der gonorrhöischen Infection für die Entstehung schwerer Genitalaffectionen bei der Frau. Verhandlungen der deutschen Gesellschaft für Gynäkologie, IV. Kongress, 1891, p., 359.

Ref. Centralbl. f. Gynäkologie, Bd. XV, p. 448, 1891. Ref. Journal of Obstetrics, Vol. XXIV, p. 1265, Nov., 1891.

‡ Wertheim, Ernest. Zur Lehre von der Gonorrhoe. Verhandlungen der deutschen Gesellschaft für Gynäkologie, IV. Kongress, 1891, p. 346.

Die ascendirende Gonorrhoe beim Weibe. Bakteriologische und klinische studien zur Biologie des Gonococcus Neisser. Archiv für Gynäkologie, Bd. XLII, p. 1, 1892.

Ref. Journal of Obstetrics, Vol. XXIV, p. 1379, Nov., 1891.

Ref. Centralbl. f. Bakteriologie, Bd. XII, p. 105, 1892.

In a carefully conducted series of experiments he found that the inoculation into the abdominal cavity of certain animals of a pure culture of gonococci, which organisms he had cultivated successfully upon human blood-serum agar, would produce a localized peritonitis, provided that there was introduced at the same time a non-absorbable material. For his purposes nutrient agar sufficed. He found, however, that even in white mice and guinea-pigs, the most susceptible of the lower animals, the process remained localized, was evanescent and never fatal. The acute circumscribed seropurulent reaction consisted of a deposit of pus cells and gonococci in great abundance on the hyperæmic serosa of the bowel. Nor was this all, for in sections the gut showed the gonococci penetrating deeply under the serosa and between the muscle bundles in ever-increasing intensity for about seventy-two hours, after which the multiplication of the organisms would cease and they would become more difficult of cultivation. The control animals would invariably recover. In his entire series of laparotomized animals no instance of mixed infection was encountered, and he recovered the introduced organisms in pure culture, and afterwards conclusively demonstrated their nature by the production of a specific anterior urethritis in man.

He further demonstrated that in a considerable percentage of cases of chronic salpingitis, which, from the absence of any growth upon ordinary media had previously been supposed to be sterile, a pure culture of gonococci could be obtained upon his blood-serum agar. Similarly from two cases of ovarian abscess he isolated pure cultures of these organisms.\*

By his experimental and pathologic studies, therefore, Wertheim showed that the gonococcus was capable of multiplication upon the peritoneal serosa and in the tissues, and of inducing an acute localized, though evanescent, peritonitis. Similar occurrences in the human peritoneum and the possibility of a diffuse peritonitis of similar nature remained undemonstrated.

Wertheim† in a subsequent report published a case in which, during a laparotomy for salpingitis, he found an extensive acute pelvic peritonitis. In the exudate he demonstrated gonococci and succeeded in cultivating them on his blood-serum agar. The abdominal ends of the tubes were open and discharging pus. The fimbriae were free from adhesions. Had the process been left to itself it would have gone on to organization of the exudate and the formation of extensive pelvic adhesions, the usual sequel of these conditions. The author believes this to be the first assured case of acute gonococcal infection of the peritoneum in a human being.

Since Wertheim's communications occasional contributions

\* The frequent demonstration by other observers since Wertheim, of gonococci in the pus of ovarian abscesses, when the organisms are no longer demonstrable in the chronic peritonitis about the appendages, is most naturally explained on the supposition that the bloodclot of a ruptured follicle offers a more favorable culture medium for their maintenance than does the peritoneal serosa.

† Wertheim, Ernest. Ein Beitrag zur Lehre von der Gonokokken-peritonitis. Centralblatt für Gynäkologie, Bd. XVI, p. 385, 1892.

Ref. Centralbl. f. Bakteriologie und Parasiten, Bd. XII, p. 108, 1892.

to the subject have been made by various writers, all of rather negative value.

Menge,\* at the Tenth International Congress in Berlin in 1891, reported the results of examination of twenty-six cases of purulent salpingitis. He found micro-organisms on eight occasions and gonococci on three, but, like Bumm, he failed to demonstrate the latter in inflammatory processes of the peritoneum. Menge, however, unlike Bumm, does not commit himself, but leaves the problem unsolved as to whether the acute and chronic pelvic peritonitides, which we find accompanying purulent gonorrhœal salpingitis, are due to a specific gonococcal infection, or to the chemical irritation of the overflowing secretion, or are the product of a definite mixed infection.

Zweifel,† in his discussion of Menge's paper, gave the conclusions drawn from a great number of personal observations, namely, that the formerly denied sequence of infection of the abdominal cavity with gonococci stood in contradiction to clinical experience. He believed in the existence of a gonococcal peritonitis, and that the organisms can be found only in the very acute cases, such as, for example, do not last longer than a week. He acknowledged, however, that definite proof to support this statement had not yet been brought forward.

Similarly Charrier,‡ in Pozzi's clinic was not able to cite a definite instance of such acute gonococcal peritoneal inflammation, although he believed in its existence. He considers it a short-lived process and one complicated, as a rule, by concomitant infection with other pyogenic cocci.

Menge reported a case to the Gesellschaft für Geburtshilfe in Leipzig, in 1893,§ in which, following the correction, under anæsthesia, of a retroflexed uterus associated with a small pyosalpinx, a general peritonitis supervened. Zweifel operated and found a double pyosalpinx with beginning general peritonitis. The pus from the tubes showed a few gonococci on culture. None, however, could be demonstrated on cover-slip preparations. The abdominal contents were negative culturally, nor could any organisms be found on stained preparations. The patient recovered and Menge believed that the peritonitis was attributable less to the micro-organisms than to ptomaines present in the pus. He believed that they were dealing with a purely chemical peritonitis.

The principle which Bumm had laid down, namely, that peritoneal infection after gonorrhœa was more apt to occur after menstruation, parturition, &c., soon became emphasized by the reports of cases in the literature tending to disprove the common belief that the infection to involve the general cavity must be a mixed one. The observations alluded to did this,

however, more because of negative findings of the pyogenic group than by any positive demonstration of the existence of the gonococcus alone.

Veit,\* in 1893, reported five cases in which the symptoms of acute diffuse peritonitis had occurred in women in child-bed, who had become infected in two instances shortly before the confinement and in three during the puerperium. In these cases after a stormy period of a few days the threatening symptoms disappeared, leaving a condition of chronic gonorrhœal pyosalpinx. Veit declared that the peculiar anatomical condition present in the puerperal state occasioned the rapid onset of the peritonitis and offers the suggestion that possibly the lochia affords a good culture medium for gonococci, a view which Bröse† holds because of the observation that one often finds during the child-bed period, the gonococci in great abundance in old infected cases which previously were in such a quiescent state that few, if any, organisms could be demonstrated in the discharges.

Penrose‡ reports a somewhat similar case of a colored woman who, four weeks after her confinement, contracted an acute gonorrhœa, which was followed in six days by symptoms of acute peritonitis. A laparotomy was performed disclosing general peritoneal involvement with a recent double salpingitis. Both tubes were removed. Unfortunately the value of this case was lost by the failure to investigate the bacteriology of the peritonitis and the uncertainty of the pathological report on the tissues which had been removed.

Chaput,§ also cites a case in a girl of seventeen, in whom a general peritonitis followed a double pyosalpinx. The abdominal openings of the tube were patent, and pus could be squeezed from them. The patient died of "paralysis of the intestine." Chaput considered the case an example of general gonococcal peritonitis.

Körte|| also, in his second report on peritonitis, describes a case (No. 20) in which a general peritonitis, sudden and with great collapse, followed the rupture of a pyosalpinx. The patient recovered after the laparotomy which disclosed a pronounced degree of peritonitis in the exudate of which a few intracellular diplococci were found. Unfortunately they could not with surer be demonstrated to be gonococci.

In 1896, Bröse¶ reported two cases of non-puerperal peritonitis for which he held the gonococcus alone responsible. As in Menge's case, referred to above, the cause of the peritonitis on one occasion was the rupture during manipulation of a small gonorrhœal pyosalpinx. Signs of collapse and

\* Veit, J. Frische Gonorrhoe bei Frauen. Dermatologische Zeitschrift, Bund. I, p. 165, 1893.

† Bröse, P. Ueber die diffuse gonorrhoeische Peritonitis. Berliner klin. Wochenschr., Bd. XXXIII, p. 779, Aug. 31, 1896.

‡ Penrose, Chas. B. Acute Peritonitis from Gonorrhœa. Medical News, Vol. LVII, p. 16, July 5, 1890.

§ Chaput. Péritonite blennorrhagique, etc. Bulletins de la Société Anatomique de Paris. Année 69, p. 9, 246, 1894.

|| Körte, W. Weitere Bericht über die chirurgische Behandlung der diffusen Eiterigen Bauchfellentzündung. Mittheilungen aus den Grenzgebieten der Medizin und der Chirurgie, Bd. II, p. 167, 1897.

¶ Bröse, P. Loc. cit.

\* Menge, K. Ueber die gonorrhoeische Erkrankung der Tuben und des Bauchfells. Zeitschr. für Geburtshilfe und Gynäkologie, Bd. XXI, 1, p. 119, 1891. Ref. Centralbl. f. Gynäkologie, Bd. XVII, p. 457, 1893.

† Zweifel. Verhandlungen des X. Internat. Medic. Congresses, Berlin, 1890. Bd. III Abeth. 8. Gynäkologie, p. 176, 1891.

‡ Charrier, P. De la péritonite blennorrhagique chez la femme. Thèse de Paris, 1892.

§ Menge. Ueber Laparotomie bei geborstener Pyosalpinx.

Centralblatt für Gynäkologie, Bd. XVII, p. 457, 1893.

general peritonitis followed. In the light of Wertheim's and Veit's observations, Bröse, although urged to intervene, withheld operation, and after four days the symptoms subsided. His second case was one of a spontaneous rupture of a gonorrhœal tube. Here also extreme symptoms, not only of pelvic, but of a generalized inflammation with profuse vomiting, extreme meteorism and collapse so marked that the case looked hopeless, followed. Again operation was withheld, and by the sixth day all symptoms had subsided. Bröse naturally believed that these peritonitides, differing so greatly in their course and prognosis from the ordinary streptococcus and staphylococcus invasions, represented a distinct form of peritoneal infection. Their symptoms, such as great pain, general tenderness, vomiting, meteorism, singultus, high temperature, small and frequent pulse, are the same as those of general peritonitis from any cause. Their prognosis is however widely different, as complete recovery, except for the chronic condition left in and about the appendages, is the usual outcome. He acknowledges, however, that as no case has been confirmed by section, the pathologic anatomy and the bacteriology of "gonorrhœal peritonitis" are only matters of conjecture.

During the discussion\* which followed Bröse's report, the apparent verdict was "not proven." Dührssen believed that he had seen two cases similar to those reported, and he had treated them also in an expectant manner. He regarded the fresh cases, where only endo-salpingitis existed, as the most dangerous for the production of general peritonitis, for in them the abdominal ostia are not closed. A previous pyosalpinx with adhesions naturally renders its occurrence less likely. Baginsky, at this time reported a fatal case in a child following a vulvo-vaginitis of gonorrhœal origin. Unfortunately no note was made on the bacteriological findings of the peritoneum at autopsy. Kiefer expressed doubt as to the extent of the process in Bröse's cases, believing that a local peritonitis might have given similar symptoms. He truly said, "Einen wirklich einwandfreien Fall von diffuser gonorrhöischer Peritonitis giebt es bis jetzt nicht."

Bland Sutton† later in the same year briefly reported a case which almost filled the requirements demanded by Kiefer. It was that of a young girl presenting acute abdominal symptoms supposed to be of appendicular origin. On opening the abdominal cavity he found pus leaking from the ostia of the tubes, which were as large as the thumb, and a general peritonitis of a peculiar form with free purulent fluid described as "gummy." This fluid contained "myriads of micrococci and an abundance of gonococci." The patient was found subsequently to have had a vaginal discharge for three months.

The infection here was regarded as a mixed one, though the variety of "micrococci" was not given. Bland Sutton's report is brief, and no note is made concerning any relation to catamenia or other ætiological factor in the spread of the infection.

If this case is to be regarded as one of general gonococcal

peritonitis, it and Wertheim's (l. c.) are the only two which I have been able to discover in a careful search of the literature which carry any convincing proofs of such an origin.

It is hoped that the two following cases, in which the condition was unsuspected and the diagnosis not made until the gonococci were demonstrated in the abdominal cavity, are sufficiently conclusive to establish beyond question the existence of a diffuse pure gonococcus peritonitis.

CASE I.—Surg. No. 7719.—*Acute Abdominal Symptoms during Menstruation and following Gonorrhœa. Laparotomy. General Peritonitis. Recovery.*

Mollie C., a maid, aged 25 years, was admitted to Dr. Osler's service May 20, 1898, complaining of abdominal pain.

Her history given on admission was without note. There was nothing to call attention to any pelvic disturbance. She denied the possibility of gonorrhœal infection, and a cursory pelvic examination was negative. Catamenia had always been regular.

The patient stated that four days previously her usual menstrual period had begun. Two days later after an exposure to cold, having fallen asleep in a draught while drying her hair, the flow partially ceased. The same day she began to have some sharp colicky pains in the abdomen and back, but kept at work until the day before admission, when the pain became more severe and quite constant. She remained in bed. Her bowels were constipated. She had some pain in the abdomen during evacuation of the bladder. The next day she was admitted to the medical wards from the dispensary by Dr. Frank R. Smith.

On admission the patient was very much excited and restless, and the history and examination were equally unsatisfactory. The temperature was 100.5°; pulse 110, of good quality; respiration not accelerated. A leucocytosis of 19,000 was present. She was flushed and had a thickly coated tongue. She lay with her knees drawn up.

The abdomen was symmetrical, somewhat full in the umbilical region. Liver dullness extended from the sixth rib to the costal margin. Neither liver nor spleen were palpable. There was no dullness in the flanks; no rose-spots. The only areas of tenderness which the patient acknowledged were in the upper zone of the abdomen. Some muscle spasm was elicited on palpation there. There was no rigidity. Rectal and vaginal examinations were negative (though the patient subsequently said they gave her great pain).

The following day the symptoms became more pronounced. General abdominal tenderness was more marked; the temperature rose to 102.8°; the leucocytes to 22,000. She was transferred to the surgical side for exploration.

Operation May 21, 1898, ether anæsthesia.

*Median exploratory laparotomy. General peritonitis. Acute double salpingitis. Gonococci demonstrated. Salpingectomy. Peritoneal toilette. Drainage.*

An incision was made through the inner border of the right rectus muscle. On opening the peritoneal cavity no free fluid, but a deeply injected serosa quite universally covered with a deposit of yellow fibrin, was found. The appendix was immediately sought for. It was deeply injected and covered with flakes of "lymph," but there was no evidence of perforation, adhesions or anything identifying it as the source of trouble. Cultures and coverslip preparations were made from the surface of the appendix, and a flake of fibrin was removed for examination. While the coverslips were being examined a systematic examination of the abdominal viscera was made.

\* Berliner klin. Wochenschr., Bd. XXXIII, p. 261, Mar. 23, 1896.

† Sutton, J. Bland. Some interesting pelvic cases. Brit. Med. Journ., Vol. II, p. 1309, Oct. 31, 1896.



The serosa of the uterine appendages and pelvis presented no evidences of an older process than that covering the appendix and right iliac fossa. The incision was enlarged and the small, bowel everted while the region of the stomach, liver and gall-bladder were explored. No perforations could be found. There was the same injection and deposit of lymph everywhere. The under surface of the liver was covered quite uniformly with a thick deposit. The coverslip examination meanwhile was reported as showing a deeply staining biscuit-shaped coccus, for the most part intracellular, occurring in pairs and not decolorizing by Gram's method. This led to a further examination of the Fallopian tubes. Like the rest of the exposed viscera, they were deeply congested and quite abundantly covered with lymph; they were somewhat swollen, but not markedly so. There were no adhesions of any note about them, and the fimbriae were free. Both appendages presented the same appearance. On gently squeezing the tube and stripping it toward the free end a thick drop of purulent material could be made to appear much like that seen at the external meatus in gonorrhoeal urethritis in the male. An abundance of organisms with the morphology of gonococci were demonstrated in the pus.

Both tubes were removed. The abdominal cavity was thoroughly irrigated with salt solution, and much of the lymph wiped away with salt sponges. The abdominal wound was partly closed, and two drains of gauze wrapped in rubber protective were left leading to the stumps of the tubes.

The patient was quite ill for two days after the operation; restless, with dry tongue, meteorism, vomiting and general appearance of peritoneal infection. She subsequently made a complete recovery. The protective wicks were withdrawn on the fourth day and the wound closed immediately. Doubtless the drainage was unnecessary.

There was a little irregular bloody discharge from the vagina, with some leucorrhœa for a few days. No organisms could be positively identified as gonococci in the urethral or vaginal secretions.

After the operation this additional note was obtained from the patient. She had been exposed to infection for five years or more, and for two years had had some menstrual irregularity, the flow at times being replaced by leucorrhœa. For some months she had had quite a profuse leucorrhœa and considerable burning pain with micturition. She had been exposed to re-infection a few days before her menstrual period.

#### BACTERIOLOGICAL REPORT BY DR. HUGH H. YOUNG.

**Peritoneum.**—Smears and cultures were made from the large flakes of fibrin which were adherent to the intestines; very little fluid pus present. The smears showed pus cells and fibrin without bacteria. Cultures made on agar slants are negative after several days in the thermostat.

Cultures on ascitic-fluid agar (inoculated with pus and fibrin which had been on an agar-slant for twenty hours) show no growth after many days in the thermostat.

**Fallopian tube;** surface burned; tube incised with sterile knife. Smears from pus show leucocytes and epithelial cells, and numerous bacteria resembling morphologically the gonococcus. Most of them are inclosed within leucocytes in numbers varying from two to sixteen, typical biscuit-shaped, grouped generally in

pairs, sometimes in tetrads. No other bacteria present. After Gram's stain all are discolored.

Diagnosis, *gonococcus*.

Cultures were unfortunately not taken from the tubes.

**Note.**—The negative result of inoculations of large amounts of fibrin and pus from the peritoneal cavity upon ordinary agar slants practically excludes the possibility of the presence of the ordinary organisms of peritonitis.

The absence of growth on ascitic-fluid agar signifies nothing, as the medium was inoculated from the surface of an agar-slant twenty hours old. While the positive cultural evidence of the presence of the gonococcus in this case would have been desirable, the certain identification of the organism in the tube and the absence of growth on the ordinary media makes the diagnosis of gonococcus infection convincing.

The demonstration in this case of gonococci on coverslip preparations from the peritoneum made and examined during the operation showed that the peritonitis was not simply of a chemical nature, as the negative cultural findings upon the ordinary media inoculated in the operating room might otherwise have led us to believe. The routine immediate examination of the flora of the exudate in cases of peritonitis often is of the greatest service to the operator, and may give a distinct clue to the prognosis and proper treatment of the case. Had no such examination been made in this instance possibly the source of the infection might not have been recognized, and not improbably the peritonitis have been regarded as a chemical one, as Menge believed it to have been in his case. Negative bacterial results have characterized nearly all of the observations previously mentioned in this report, except the experimental ones of Wertheim. Whether "chemical" peritonitis, so-called, has any actual existence remains a question of doubt. Tavel and Lanz\* recognize such a condition, while Flexner† has never failed to find organisms in his 106 cases of peritonitis examined after death. The pathologist doubtless may be less likely to encounter these rather benign cases than the surgeon, but it is possible that some of the "chemical" cases described by surgeons may be, after all, of bacteriologic origin, though difficult to recognize, as was the one here reported.

CASE 11. Surgical No. 7799. *Acute abdominal symptoms during menstruation simulating appendicitis. Laparotomy. General peritonitis. Recovery.*

M. B., a factory girl, aged 18, was admitted to Dr. Osler's service May 30, 1898, complaining of pain in the right side of the abdomen, with persistent nausea and vomiting. The menarche history relative to her condition which could be obtained at entrance was as follows: Six days previously she was awakened in the morning with abdominal pains so severe that she could not get up. Up to this time she had been perfectly well. Her bowels were constipated for some days after this onset, and she had been constantly nauseated with frequent spells of prolonged vomiting, which had increased of late. She had been hiccupping some. All disturbance with micturition and menstruation was positively denied at this time. Her pain had been constant and always in the right

\* Tavel, E., und Otto Lanz. Ueber die Aetiologie der Peritonitis. Mittheilungen aus kliniken und medicinischen Instituten der Schweiz, I Reihe, I Heft., 1893.

† Flexner, Simon. The Etiology and the Classification of Peritonitis. Philadelphia Medical Journal, Nov. 12, 1898.

iliac fossa. She had had no chill and was unaware of any pyrexia. Her general appearance was that of collapse, with peritonitis.

She was seen by Dr. Halsted in consultation with Dr. Thayer, and a provisional diagnosis was made of general peritonitis presumably of appendicular origin.

She was immediately taken to the operating room, where the following note was made before anesthetization: "The patient is a young woman with flushed cheeks, a thickly-coated tongue and a general appearance of acute toxæmia. Her respirations are costal in type, somewhat accelerated—thirty-four to the minute. Pulse is 100, rather small, but regular and fairly good quality. Temperature is 98.6°. Her extremities are cold, but not clammy as from collapse. There is a leucocytosis of 26,000.

*Abdomen.*—There is no distention. On the left side there is no rigidity or muscle spasm and no apparent tenderness. Tenderness on the right side is marked, but protective spasm is not a prominent feature. There is a definite point of tenderness two or three centimetres to the right of the umbilicus on a line to the anterior spine. Percussion note has about the same quality over the whole abdomen, with no dullness in the flanks."

The patient insisted that her chief tenderness was in the epigastric region. A vaginal examination which had been made in the ward previously was reported as negative, except for an absent hymen and slight vaginitis.

Operation May 30, 1898, 2 P. M. Ether anesthesia.

*Exploratory laparotomy. General peritonitis. Gonococci demonstrated in exudate. Double salpingectomy. Irrigation and drainage.*

An incision was made over the site of the appendix. On opening the peritoneal cavity the whole serosa was found greatly injected and quite uniformly covered with a layer of fibrin. There was no free fluid; no pus. The appendix was found to be deeply congested and covered with "lymph," but in no respect differing from the appearance of the rest of the bowel. The distribution of the exudate was so uniform that (as in Case I) there was nothing to draw attention to any particular organ in searching for the origin of the peritonitis.

The under surface of the liver, the spleen, stomach and pelvic viscera, all were deeply injected and more or less thickly covered with exudate. This seemed especially abundant on the under surface of the liver, from which it could be peeled off in large flakes, leaving a raw surface exposed.

The tubes were examined early in the search, as the peculiar character of the peritonitis resembled so closely that seen in Case I. They were, like the appendix, congested and covered with lymph, but the fimbriæ were free and there was no evidence that the pelvic peritonitis antedated that in the upper portion of the abdomen. Only after a careful examination of the gall-bladder, stomach, mesenteric glands and bowel were the tubes re-examined when, with some difficulty, it was found that a purulent drop could be brought to the abdominal ostium.

Coverslip preparations were immediately made from this pus, and a biscuit-shaped diplococcus decolorizing by Gram's method was demonstrated in moderate numbers. Cultures were made on various media from this material and from different parts of the abdominal cavity, and a sheet of fibrin about three centimetres in diameter was stripped from the under surface of the liver for future study, and by chance was dropped in a bouillon tube.

Both tubes were removed, the pelvis was carefully wiped out with saline sponges, the intestines irrigated and much of

the thick fibrin sponged off. The abdominal wound was partly closed, leaving a small drain leading into the pelvis.

The patient made a satisfactory and complete recovery.

An attempt, made subsequent to the operation, to demonstrate gonococci in the vaginal discharge was unsuccessful. The following important feature of the history was obtained after the operation. She had been frequently exposed to infection for a year and had had considerable leucorrhœa for six months, with some burning and cutting pain during micturition. Several days before her last menstrual period she was re-exposed after a long interval of freedom, and had a return of abundant discharge. Menstruation began as usual, but ceased after three days with the onset of the abdominal pain and vomiting, leucorrhœa and ardor. The patient to protect herself had referred her pain to the epigastric region, and denied any tenderness on pelvic examination.

The appendicular tenderness is an interesting feature. Possibly the great congestion of the organ may have been responsible for the tenderness on pressure near McBurney's point.

#### BACTERIOLOGICAL NOTES BY DR. YOUNG.

May 30, 1898.—A coverslip preparation from the purulent contents of the right tube shows many pus cells and a considerable number of diplococci, with typical morphology of the gonococcus, mostly intracellular. Some cells contain a number of cocci, one showing as many as twenty-five. All completely decolorized by Gram's method.

*Diagnosis, gonococcus.*

Smear from peritoneal cavity (poor preparation; stains badly) shows four typical gonococci, all intracellular; too few to decolorize.

Cultures: 1. Bouillon culture from pus from peritoneal cavity shows no growth after three days in thermostat.

2. Another bouillon tube, into which a large mass of fibrin stripped from the under surface of the liver was dropped, shows slight cloudiness in the bouillon at the bottom of the tube (around the fibrin) after three days in the thermostat. Coverslips made from this show numerous, fairly large diplococci, biscuit-shaped and otherwise typical, morphologically, of the gonococcus. Numerous coverslip preparations were made, and all show diplococci in great numbers and nothing else. All decolorize by Gram's method.

Cultures from this bouillon and also from the fibrin show no growth on ordinary agar after many days in the thermostat.

3. A hydrocele fluid-agar tube was inoculated with a small mass of fibrin which was removed from Douglas' pouch. After twenty-four hours in the thermostat five small, transparent, pin-point colonies were seen on the surface of the medium adjacent to the fibrin. At the end of forty-eight hours they are as large as a small pin-head and semi-translucent in appearance.

Slide-smear preparations show diplococci, morphologically the same as gonococci in pairs and tetrads. All are completely decolorized by Gram.

Transfers on agar from colonies on the hydrocele-agar show no growth after many days in the thermostat.

*Diagnosis, gonococcus.*

*Note.*—The growth of the gonococcus in ordinary bouillon into which a large mass of fibrin had been dropped is interesting. As is well known, the gonococcus grows well in Marmorek's human serum bouillon (composed of one-third human blood-serum and two-third bouillon) and it seems probable that the fibrin in this instance added the chemical ingredients which sufficed to convert the ordinary bouillon into a fluid resembling this mixture.

The growth was very abundant, and the typical morphology,



decolorization by Gram, and negative growth on agar made the diagnosis of gonococcus positive.

The fact that this culture was taken from just beneath the liver is also conclusive evidence that the gonococcus infection was general throughout the peritoneal cavity.

The similarity of these cases is very striking. In both there was a diffuse involvement of the general peritoneal cavity occurring during menstruation and following a recent exposure to infection associated with the exacerbation of a preëxisting leucorrhœa. Apparently the uterus and tubes at such a time are less able to resist invasion, and an acute gonorrhœal process may the more rapidly ascend from the cervix through the patent abdominal ostia to the serosa. In both cases the onset of abdominal symptoms was sudden with pain and vomiting, but without the shock and collapse seen in perforative peritonitis. In neither case was abdominal tenderness a marked feature, nor was there any distention from paralysis of the bowel as would have been expected with such a pronounced degree of peritonitis under ordinary circumstances. No information was gained by pelvic examination, as both patients concealed the nature and seat of the trouble. The examination of the appendages, however, under more favorable circumstances would have been negative, as the tubes were patent and there had been no accumulation in the lumen. Leucocytosis was pronounced in each case.

The character of the peritonitis in both was the same; a dry fibrinous peritonitis having, as Bröse has said, a distinct individuality. There was practically no pus or serous exudate. In the pelvis there was no evidence that the process had been of longer duration there than elsewhere. The whole serosa was uniformly injected and the deposit of fibrin on the liver and spleen was so thick that it could be stripped away, showing that there was an extensive dissemination of the infectious agent, whether the gonococcus itself or some chemical product of its growth. The fibrinous pseudo-membrane, however, was not essentially of the adhesive kind. Adhesions even in places where the "lymph" was thickest were not a pronounced feature.

From our knowledge of the self limitation of the gonococcal peritonitides and from Bröse's clinical observations, it seems probable that both of these cases might have recovered without operative intervention, but probably with a following chronic pyosalpinx which would subsequently have demanded operation.

Microscopical sections of the tubes showed, especially in Case I, an advanced degree of endo-salpingitis with leucocytes and broken-down epithelial debris in the lumen, and great congestion of the sub-epithelial tissues, which contained many leucocytes with greatly fragmented nuclei. The tubes in Case II showed a much less marked catarrh; one of them indeed (left), being only slightly abnormal. This case, however, showed possibly the most advanced peritonitis and the more severe symptoms. Attempts to demonstrate the organisms in the stained sections were unsuccessful.

The gonococcus has made a place for itself as one of the most important pathogenic bacteria. Few organisms, not even

the bacillus typhosus, rival it in the number of suppurative sequelæ which may follow a primary infection. Its occurrence in the conjunctiva, and in the iris, the joints, bursæ and tender sheaths; its occasional demonstration, as the cause of endo- and pericarditis, pleuritis and phlebitis, and the recent observations of cases of pure septicæmia\* with its cultivation from the blood shows that its possibilities for metastatic complications are as numerous as are those arising from the spread of infection by direct continuity of surfaces. A general peritoneal involvement by direct extension of an unmixed gonorrhœal process, though long considered among these possibilities has heretofore remained unproven. It adds another variety to the peritonitides of mono-infection which are rare except when of hæmatogenous origin.

#### CONCLUSIONS.

1. The gonococcus is capable of causing a specific infectious disease, namely, gonorrhœa and at the same time other and less specific pathological conditions.

2. There is experimental proof that in certain small animals the gonococcus can set up acute alterations in the peritoneum homologous with the acute septic serositides in man, but differing from these in their tendency to rapid and spontaneous healing.

3. Hitherto there has been wanting conclusive proof that in the peritonitides attendant upon gonorrhœa occurring in women, the gonococcus was solely or chiefly concerned. The inflammations had been variously regarded as mixed infections and chemical inflammations.

4. The cases reported in this paper bring for the first time convincing evidence of the existence of a diffuse, general inflammation of the abdominal cavity caused by the gonococcus.

5. It has been recognized that extension of the gonorrhœal infection from the genital organs to the peritoneum may occur in the puerperal state; a similar sequel is shown to be possible during menstruation.

6. Such ascending forms of gonorrhœa doubtless under ordinary circumstances remain localized in the pelvis, and rarely demand surgical investigation in the acute stage.

7. A general involvement of the peritoneum such as occurred in the two cases given, must either be rare or unrecognized, and may depend upon some especially receptive condition of the serosa or virulence of the organism.

8. The peritoneum is not more immune than are the peri- or endocardium to gonococcal infection, and being more exposed, suffers more commonly in females, although the relatively benign course of the disease makes it a rare condition to come to the attention of the surgeon in the acute stages.

\*Colombini, P. Bakteriologische und experimentelle Untersuchungen über einen merkwürdigen Fall von allgemeiner gonorrhöischer Infection. Centrabl. f. Bakteriologie, u. s. v., Bd. XXIV, No. 25, p. 955, Dec. 30, 1898.

Thayer and Lazear. A second case of gonorrhœal septicæmia and ulcerative endocarditis, &c. The Journal of Experimental Medicine, Vol. IV, No. 1, pp. 81, 1899.



# A CASE OF ATROPHY OF THE OPTIC NERVES FOLLOWING HEMORRHAGE FROM THE STOMACH, WITH A CONSIDERATION OF THE CAUSES OF POST-HEMORRHAGIC BLINDNESS.

By SAMUEL THEOBALD, M. D.,

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Loss of vision as a consequence of hemorrhage from the stomach is an occurrence of sufficient rarity to warrant the reporting of every well-authenticated case of this character. In a paper upon "Amaurosis and Amblyopia after Hæmatemesis," by Dr. Ed. Pergens, of Brussels, in the January number of the *Annales D'Oculistique* for 1896, the author, after a seemingly exhaustive search of the literature of the subject, has been able to bring together data of but 64 published cases, two of these being newly reported cases of his own.

The unanimity with which the text-books upon diseases of the eye mention excessive hemorrhage, and especially hemorrhage from the stomach, as one of the causes of optic neuritis, would seem to indicate that cases of this character are of not infrequent occurrence—a conclusion scarcely warranted, I am inclined to believe, by the facts.\*

Briefly reported, the case which has recently come under my observation is as follows:

A. B., æt. 57, formerly a lumberman of West Virginia, and more recently a restaurant keeper in one of the small towns of that State, was first seen December 5, 1898. He gave a history of serious disturbance of the stomach of twenty years' duration, the most prominent symptom being frequently repeated attacks of vomiting. On the 6th of May (1898) he had, for the first time, a hemorrhage from the stomach. It was of severe character, and was followed, at intervals of forty-eight hours, by two other equally severe hemorrhages. The loss of blood was so great that his life was despaired of, and he was confined to bed for six weeks. For part of this time (two or three weeks), according to his account, he was in a semi-conscious state—was aware of the presence of people about him and could hear their voices, but could not speak to them or express his wants.

On the day of the second hemorrhage his sight, which had previously been good, became greatly impaired, and his belief is that during the two succeeding weeks he was "entirely blind." At the end of this period his vision began to improve, and he was able to see people moving about the room. This improvement in vision continued, so that by the last of June or first of July he could see well enough to walk upon the streets without guidance; and this amount of vision he retained until about the middle of November, when his sight began again to decline. The decline from this date was pretty rapid, so that when I saw him he had to be led about like one entirely blind. He admitted that he had been a pretty constant smoker, but denied having been a hard drinker, and also denied having had syphilis.

\* I have been able to find in the Catalogue of the Surgeon General's Library, under the title "Inflammation of the Optic Nerve," but a single reference to optic neuritis following hemorrhage.

The condition of his stomach was carefully investigated by Dr. Osler and Dr. Thayer, who found a nodular mass near, and partially occluding, the pyloric orifice, which they regarded as the result of a chronic ulcerative process, the indications pointing to a more recent development of a malignant growth in the old cicatricial tissue.

The examination of the eyes gave results as follows: Pupils semi-dilated, somewhat oval in shape and entirely unresponsive to light. The ophthalmoscope showed advanced atrophy of both optic nerves, with some cupping, and marked contraction of the retinal arteries. The optic discs had a woolly appearance, their outlines were irregular and ill-defined, and in each eye there were pigment changes in the retina, not only about the margin of the disc but at points some distance from it and especially in the macula region, indicating that the atrophy of the nerves had been preceded by an inflammatory process which had involved the retina as well as the optic nerves. Upon testing his vision, I found that with each eye he was able to count fingers at about 12", but only in a very limited part of the field, which in each eye was slightly to the temporal side of the central fixation point.

After an interval of eight days, he having meantime been under treatment in the Johns Hopkins Hospital, he thought his sight somewhat better, and I found that he could then distinguish with each eye Snellen C. at about 10". An attempt was made at this time to take his visual fields; but this was very difficult and the result unsatisfactory because of his macula blindness and consequent inability to maintain central fixation. The result obtained in the right eye is shown in the accompanying diagram; the attempt as to the left eye was abandoned. Although there seemed but little probability that his sight could be improved by any plan of treatment, he was placed upon small doses of hydrarg. biniodid. with potassium iodid. and increasing doses of strychnine sulphas.

Although, as has been said, the text-books, almost without exception, speak of loss of sight following severe hemorrhage from the stomach, usually ascribing this result to optic neuritis, they have but little to say as to the way in which the loss of blood induces such disturbances in the visual apparatus.

The theory, advocated by Samelsohn\* and others, that the optic neuritis is not due to the loss of blood, but that it and the diseased condition of the stomach which induces the hæmatemesis are both dependent upon a central lesion, probably in the optic thalamus, does not seem to be tenable; for we know that other severe hemorrhages, as well as those from the stomach, are followed by loss of sight. Thus Friest states that while 35½ per cent. of the reported cases of amblyopia from loss of

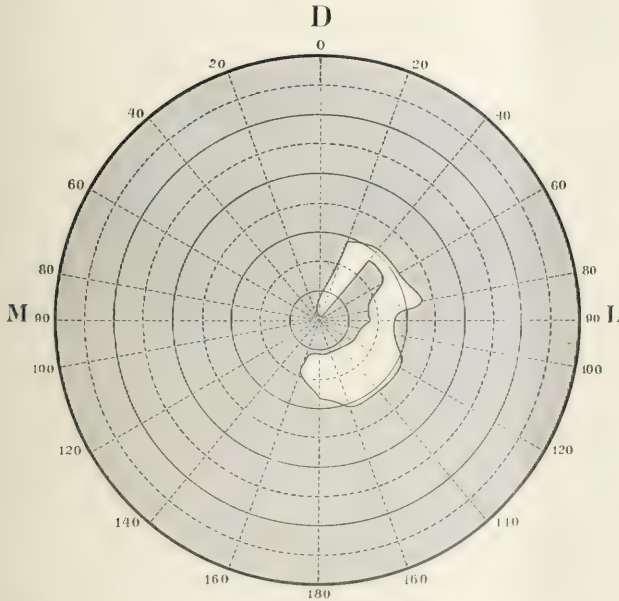
\* Graefe's Arch., Vol. XXI, 1, p. 150.

† *Klinische Monatsblätter f. Augenheilkunde*, 1878.

, less marked contraction of the veins, specially about the disc and the macula, at the macula, and occasionally, hemorrhage grounds for believing that many of past have been regarded as *embolism* of the retina were, in fact, cases of *throm-*

s picture, let us consider, more in detail, findings described in Pergus' paper and agree. In the twenty earlier examinations, are the more instructive, we find conditions:

	Cases.
.....	5
cially arteries.....	2
.....	2
very thin.....	1
is dilated.....	3
mention of contracted arteries.....	13
.....	11
.....	1
.....	2
white.....	1
vas ischemia of the disc.....	15
.....	7
with cherry-colored macula.....	2
xudates, etc., in retina.....	3
ere characteristic changes in the retina	12
r upon optic disc.....	8



least, three instances the typical picture circulation—the case in which the and the two cases in which there was with the red spot at the macula—and is safe to say, I think, that the condition accounted for more satisfactorily upon any other.

are two cases in which the retinal venous (vision being recovered in each); es were slightly enlarged and tortuous o; one in which the veins were dilated present in each eye; and one in which “arrested circulation,” all the retinal l in size. In the three last-mentioned point to interference with the venous n with the arterial. This might beurrence of a hemorrhage into the rve, as suggested by Samelsohn, or by trial retinal vein, although it cannot be istic signs of this latter condition were se cases. In this connection, however, it n a case of marked impairment of vision ine hemorrhage, observed by Dr. Harry more, in which the ophthalmoscope e typical picture of thrombosis of the

## A CASE OF ATROPHY OF STOMACH,

### *Clinical Pro*

Loss of vision as a consequence of stomach is an occurrence of sufficient reporting of every well-authenticated case. In a paper upon "Amaurosis and Amblyopia," by Dr. Ed. Pergens, of Brussels, published in the *Annales D'Oculistique* for 1881, after a seemingly exhaustive search of the literature, he has been able to bring together data of 11 cases, two of these being newly reported cases.

The unanimity with which the text-books mention excessive hemorrhage from the stomach, as one of the causes of amaurosis, would seem to indicate that cases of this infrequent occurrence—a conclusion scarcely inclined to believe, by the facts.\*

Briefly reported, the case which has attracted my observation is as follows:

A. B., æt. 37, formerly a lumberman, more recently a restaurant keeper in that State, was first seen December 5, 1881, on account of serious disturbance of the stomach, the most prominent symptom being attacks of vomiting. On the 6th of December, for the first time, a hemorrhage from the stomach of severe character, and was followed, at intervals of a few hours, by two other equally severe hemorrhages. The blood was so great that his life was dangerously confined to bed for six weeks. For the past three weeks, according to his account, he was in a semi-conscious state—was aware of the presence of his attendants and could hear their voices, but could not express his wants.

On the day of the second hemorrhage his vision, previously been good, became greatly impaired. "He is that during the two succeeding weeks he was blind." At the end of this period his vision improved and he was able to see people moving about the room. Improvement in vision continued, so that on the first of July he could see well enough to go out on the streets without guidance; and this improvement was retained until about the middle of November, when it began again to decline. The decline from the previous state was rapid, so that when I saw him he had become entirely blind. He admitted that he had been a constant smoker, but denied having been syphilitic, also denied having had syphilis.

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\* I have been able to find in the *Catalogue of the Medical Library*, under the title "Inflammation of the Optic Nerve," but a single reference to optic neuritis follows.



blood were due to hemorrhage from the stomach and intestines, 25 per cent. were due to uterine hemorrhage, 25 per cent. to abstraction of blood,  $7\frac{3}{10}$  per cent. to epistaxis,  $5\frac{1}{10}$  per cent. to bleeding of wounds, and 1 per cent. each to hæmoptysis and hemorrhage from the urethra.

The theory of Westhoff and Ziegler that the loss of vision is caused by a primary fatty degeneration of the optic nerve induced by ischæmia; as well as that of Hoffman, who attributes the amblyopia and the subsequent atrophy of the optic nerve to a retro-bulbar neuritis, seems to receive but little support from the evidence afforded by the ophthalmoscope in the majority of the reported cases.

In the paper of Pergens, already referred to, a brief abstract is given of each one of the sixty-four cases of amaurosis and amblyopia following hæmatemesis which he was able to find upon record. In a considerable number of them no ophthalmoscopic examination was made; in forty-three instances the ophthalmoscopic findings are given, but the time at which the examination was made varies greatly in different cases.

If we decide, arbitrarily, to regard all the ophthalmoscopic examinations made within three weeks of the onset of the eye symptoms as *early*, and all after this period as *late* examinations, it will be found that 20 of the 43 cases belong in the first category and 23 in the second. The early examinations are, of course, the more instructive. Now, after a careful consideration of the findings in these earlier examinations, it seems to me that, while a very few of them might, perhaps, be cited as supporting the theory of primary fatty degeneration of the optic nerve of Westhoff and Ziegler, the great majority of them point strongly to an obstruction of the blood current in the central retinal artery as the cause of the subsequent intra-ocular manifestations; and, in view of the well-recognized tendency to the formation of thrombi in post-hemorrhagic anæmia, it seems highly probable, if this theory is correct, that the obstruction was of thrombotic origin. This seems the more probable because there is, I believe, a reason why the disposition to thrombosis after loss of blood should manifest itself especially in the retinal vessels.

The occurrence of thrombi after excessive hemorrhage is to be explained by the reduction of blood pressure and the consequent slowing of the blood current, the alteration in the condition of the blood itself (especially the multiplication of the platelets), and, probably, also by changes (consequent upon anæmia) in the vessel walls. Now in the retinal circulation, beside all these general conditions, we have, in the intra-ocular tension, a special condition tending further to obstruct the enfeebled blood current. Here then, it would seem, at the point where the central retinal artery pierces the lamina cribrosa and becomes subject to the intra-ocular pressure, the ideal conditions for the development of a thrombus exist: for here we have the especial point of constriction or obstruction behind which, when other conditions are favorable, a thrombus is prone to develop. The intra-ocular pressure, doubtless, impedes the blood stream in the retinal veins also, but probably not to the same degree as in the arteries.

The ophthalmoscopic picture in thrombosis of the central retinal artery is much the same as is found in embolism of the artery, namely, paleness of the optic disc, marked contraction

of the retinal arteries, less marked contraction of the veins, opacity of the retina, especially about the disc and the macula, a cherry-colored spot at the macula, and occasionally, hemorrhages; indeed there are grounds for believing that many of the cases which in the past have been regarded as *embolism* of the central artery of the retina were, in fact, cases of *thrombosis*.\*

Having in mind this picture, let us consider, more in detail, the ophthalmoscopic findings described in Pergens' paper and see in how far the two agree. In the twenty earlier examinations, which, as before stated, are the more instructive, we find recorded the following conditions:

	CASES.
Arteries contracted .....	5
Vessels contracted, especially arteries.....	2
Vessels contracted .....	2
Arteries filiform, veins very thin.....	1
Arteries contracted, veins dilated.....	3
Total in which there is mention of contracted arteries.....	13
Optic disc, pale.....	11
Optic disc, greenish-gray .....	1
Optic disc, clouded .....	2
Optic disc, clouded and white.....	1
Total in which there was ischæmia of the disc .....	15
Cloudiness of the retina .....	7
" " " with cherry-colored macula.....	2
White plaques, miliary exudates, etc., in retina.....	3
Total in which there were characteristic changes in the retina.....	12
Hemorrhages in retina or upon optic disc .....	8

Here we have in, at least, three instances the typical picture of obstructed arterial circulation—the case in which the arteries were filiform, and the two cases in which there was clouding of the retina with the red spot at the macula—and in all of the others it is safe to say, I think, that the conditions present may be accounted for more satisfactorily upon this theory than upon any other.

Besides these there are two cases in which the retinal vessels are described as normal (vision being recovered in each); one in which the arteries were slightly enlarged and tortuous and the veins greatly so; one in which the veins were dilated and hemorrhages were present in each eye; and one in which there was a picture of "arrested circulation," all the retinal vessels being increased in size. In the three last-mentioned cases the indications point to interference with the venous circulation rather than with the arterial. This might be explained by the occurrence of a hemorrhage into the sheath of the optic nerve, as suggested by Samelsohn, or by thrombosis of the central retinal vein, although it cannot be said that the characteristic signs of this latter condition were present in any one of these cases. In this connection, however, it is of interest to mention a case of marked impairment of vision following a severe uterine hemorrhage, observed by Dr. Harry Friedenwald, of Baltimore, in which the ophthalmoscope showed in each eye the typical picture of thrombosis of the

\* Kern. Zur Embolied. Art. centr. Retinæ. Traug. Diss., Zurich, 1892.

central retinal vein. The vision of one eye was regained, but that of the other was permanently lost.

As to the evidence afforded by the ophthalmoscope in the twenty-three cases described by Pergens in which only a late examination was made, it cannot be claimed that it throws much light upon the question under consideration; for the atrophied nerves and contracted arteries usually mentioned as present might have been due to other conditions as well as to thrombosis of the central artery, and this is equally true of the case which I have reported.

The character of the visual field in my case, as well as that in several of the small number of cases in Pergens' paper, in which the field is described (vision having been retained only in a circumscribed area in the temporal field) is significant, and seems to point to the partial preservation of the retina in the neighborhood of the papilla by means of the cilio-retinal arteries.

Of the whole number of cases collected by Pergens, autopsies were made in but four. In one of these a thrombosis of the splenic artery was found, but no mention is made of the condition of the eye. In a case reported by Hirschberg\* there was complete atrophy of the optic nerve of one eye, and atrophy of a limited portion of the optic nerve of the other eye. In the affected portion of the nerve there were numerous blood-vessels with thickened walls but no thrombosis and no signs of hemorrhage in the optic nerve sheath. The death of the individual, it should be stated, did not occur until three years after the loss of vision.

In an autopsy by Ziegler,† twenty days after the attack which led to loss of vision, no macroscopic changes in the optic nerves or their sheaths were found; but the microscope showed fatty degeneration of the nerves and their intra-ocular expansion.

The only other autopsy was one made by Raehlmann.‡ All the arteries presented constricted lumina from a fibrous endarteritis. The veins also had undergone slight constriction, in

two places being almost totally obliterated. There was œdema of the retina, especially in the neighborhood of the disc. In the choroid the endarteritis was pronounced and there was hyaline degeneration. Here, too, it will be seen, we have mention of vascular changes, the thrombosis of the splenic artery in the first-mentioned case being, at least, suggestive, and the condition of the retinal vessels and of the retina itself in Raehlmann's case being especially significant.

The fact that both eyes are so frequently involved in blindness dependent upon acute anemia\* seems, at first sight, to make against the theory that the loss of vision is due to thrombosis of the central retinal artery, since it implies the occurrence nearly simultaneously, at different points, of two thrombi; but, if the intra-ocular tension plays as important a rôle in the etiology of these cases as I believe it does, this objection loses much of its force.

#### CONCLUSIONS.

1. That the weight of evidence afforded by the ophthalmoscope points to thrombosis of the central retinal artery as the usual cause of the blindness which occurs in post-hemorrhagic anemia.

2. That the resistance offered to the already enfeebled blood current in the central retinal artery by the intra-ocular tension is an important etiological factor in determining this result.

3. That, in exceptional instances, the ophthalmoscope indicates that the thrombosis occurs not in the artery but in the central retinal vein.

4. That, in other exceptional instances, it may be that the loss of sight and the ophthalmoscopic changes which accompany it are the result of a hemorrhagic or serous effusion into the optic nerve or its sheath (Samelsohn). And here, again, the obstruction and damming back of the blood current in the central retinal artery by the intra-ocular tension, probably, have much to do with bringing about this result.

## LICHEN SCROFULOSORUM IN A NEGRO.

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This case is of interest not only on account of its great rarity in this country, only four cases having been previously reported, but also because it is the first recorded instance in the negro. In the four cases already reported, one of which occurred in Canada, no microscopical examination was made.

While attending a number of negro children in an orphan asylum for tinea tonsurans, one young girl, eleven years of age, was brought to me with some lesions on the back and thighs which the attendant thought were ringworm patches

and which had been noticed a few days previously. The patient appeared to be a healthy, well-nourished girl; she was not anæmic, did not complain of anything, had a good appetite but was rather quiet in her manner. The tongue was clean. On examination there were found on the upper portion of the back a number of round and oval patches varying from about 10 to 20 mm. in diameter. A few similar patches were found on the extensor surfaces of both thighs, about the left groin, on the anterior surface of the right thigh and in the

\* Zeitschr. f. klin. Med., Vol. IV.

† Ziegler und Nauwerck's Beitr. z. path. Anat., Vol. II.

‡ Fortschr. d. Mediz., 1889, p. 928.

\* Whether one or both eyes were affected is stated in fifty-seven of the cases collected by Pergens. Of these, both eyes were involved forty-nine times; one eye only eight times.

pubic region. The patches all consisted of groups of small, conical, slightly scaly and therefore whitish firm papules, each papule being about 0.5 mm. in diameter, raised and presenting a flattened summit which was covered with a somewhat adherent but not profuse whitish scale, on removal of which a bleeding surface was exposed. The papules presented in every patch exactly the same character and were always discrete and of the same size. There was a slight red areola surrounding the base of the papules. The most recent patch presented a group of seven rather closely aggregated conical papules which were not scaly. The oldest groups which were in the groin were much larger and the central portion appeared to be clearing up, although on close examination one could still detect the remains of slightly scaling papules which were much flattened. Many of the lesions were pierced by lanugo hairs and were therefore situated around hair follicles. Two patches on the left groin were becoming confluent and thus formed an irregularly shaped area.

This case was not diagnosed absolutely at first, and numerous scales were examined in the usual way for the ringworm fungus but no evidence of any mycelium or spores could be found. The patient was seen every other day and numerous new lesions were observed developing, especially on the back as well as on the abdomen, forearms, and arms. Five weeks after the first appearance of the eruption a typical phlyctenular conjunctivitis of the right eye developed. The diagnosis was confirmed by Dr. Theobald. The distribution of the lesions at this time was as follows: A few scattered patches on the extensor surfaces of the forearms and arms; 4 patches on the right side of the chest; 5 scattered areas on the abdomen between the umbilicus and pubes; nearly 60 groups distributed over the whole back; a few extensive patches on the extensor surfaces of both thighs and numerous areas in both groins. The head, neck, hands, legs and feet were all clear.

Patches which were only two days old were seen to consist of from four to seven, conical but flattened, firm, non-scaly papules, some arranged around, others between the hair follicles. Many of the lesions presented the appearance of a keratosis pilaris. The papules always appeared in the same way, gradually developing whitish, but not profuse, adherent scales, on removal of which a bleeding surface was exposed. The patches were gradually increased in size by the addition of new papules around the periphery while the older central lesion gradually flattened but remained scaly. The lesions then assumed a circular or oval-shaped aspect with a cleared-up center. The long axis of the patches in the lumbar region was transverse to the body. When two adjoining patches approached one another the intervening papules showed a tendency to gradually disappear, but over the region of the right scapula there was a large irregular area of papules which was made up of 16 groups, none of which had cleared up in the center. A whitish collarette extended up the hairs in many of the papules in the lumbar region. No vesicles or pustules were observed clinically during the course of the disease. A few solitary papules could be detected scattered over the back. All varieties of the lesions are well shown in the photograph (Fig. 1) especially if a hand magnifier be used. There were no subjective symptoms.

A probable diagnosis of lichen scrofulosorum was made at first which was confirmed by the extension of the lesions, their uniform character and the appearance of a typical phlyctenular conjunctivitis. Numerous enlarged lymphatic glands were also present but as they occur often in healthy negroes, this symptom was not regarded as important.

The patient is the fifth of eight children (five girls and three boys), all living and in good health with the exception of one girl who died of "consumption." The father and mother are living and in good health. There is no tuberculosis in any form in the family now living.

Under the internal administration of hypophosphites and cod liver oil the cutaneous and eye troubles both rapidly disappeared. The sections all presented two striking features: (1) semiglobular-looking masses situated in the horny layer and in the majority of instances around the hair follicles, and (2) marked pathological changes in the upper portion of the corium beneath these papular masses and also around the hair follicles, especially the deepest portion. The latter was characterized by its tubercular structure. One could follow in the sections the formation of these clinical papules. Fig. II explains their genesis. The blood-vessels in the upper portion of the corium and papilla were dilated and many polynuclear leucocytes had wandered out into the tissue and into the epidermis up to the horny layer where these cells became disintegrated; numerous lymphoid cells were found in the same situation, undergoing the same processes. Thus a mass of detritus and an apparent firm ground substance is deposited in the horny layer. This ground substance takes up the eosin stain very readily while the cells take up the hæmatoxylin. There are also a few degenerated epithelial cells in the mass of detritus. The stratum lucidum and stratum granulosum have disappeared. No apparent fluid exudation accompanies this emigration of cells through the rete, and the epidermal cells are but little swollen, nor are the interepithelial spaces much widened. Large numbers of pigment granules are also scattered throughout the papular lesion.

In Fig. III is represented a section of the whole patch excised showing three papules, (*P*) all of which are well marked. One shows its relation to a hair follicle (*P'*); from the second it is evident that the section has just passed outside of the follicular opening as evidenced by the presence of the lower portion of the follicle (*H*); while the connection of the third with a hair follicle is seen in another section. The more pronounced papules show that they are made up of the same materials which have already been described, with the exception that there is a larger amount of pigment in the lesions. Directly in contact with the hair (*H*) there is a well-marked hyperkeratosis encircled by the papular lesions. This hyperkeratosis extends nearly half way down to the hair follicle. The middle papule exhibits completely the nature of the lesion just outside of the hair; it consists of a firm substance imbedded in which are enormous numbers of degenerated polynuclear leucocytes, lymphoid cells, many epithelial cells and masses of pigment granules. The mucous layer beneath consists of two layers of cells through which are emigrating hundreds of wandering cells. There is some



widening of the interepithelial spaces, but no marked edema. The corium, especially directly beneath the papules and around the hair follicles shows marked changes. In the first region there is a fairly well-defined area consisting of the papillæ and upper portion of the corium, in which are massed large numbers of lymphoid cells, numerous polynuclear leucocytes and some plasma cells with dilated blood-vessels. (Fig. III, C.)

Around the hair follicles in the lower portion are masses of chiefly round mononuclear cells, some plasma cells and epithelioid cells and a few mast cells. In four sections typical tubercles were observed in this situation (Fig. III, G), with giant cells forming the center surrounded by numerous epithelioid cells and mononuclear round cells at the periphery. The hair follicles themselves are unaffected. The blood-vessels (V) throughout the corium are dilated, are surrounded by numerous mononuclear round cells, a few plasma cells and numbers of polynuclear leucocytes. Two unaffected sebaceous glands were seen in one of the sections. The sweat ducts and sweat glands were normal, although a duct was seen passing close to the lesion. The blood-vessels accompanying the sweat duct were dilated and surrounded by additional cells as were other vessels. No tubercle bacilli were found in any of the sections stained for this purpose.

Hebra first described the disease and named it lichen scrofulosorum to characterize its clinical features. He declared that it was always accompanied by other symptoms of scrofula. The disease had been previously described as lichen simplex by Erasmus Wilson, and as lichen circumscriptus by Cazenave. Jacobi in 1891 drew attention to the tubercular nature of the lesions, which he thought to be a perifollicular tuberculosis of the skin. Although he demonstrated a single tubercle bacillus in one of his sections, an inoculation into guinea pigs gave negative results. Later (1896) he demonstrated the presence of tubercle bacilli in a typical case and obtained positive results in a rabbit. In 1892 Sack decided, after a careful histological examination, that the disease was a miliary tuberculosis of the skin, the nodules showing a central caseation, then giant cells, epithelioid cells and small round cells. He suggested "tuberculosis lichenoides cutis" as a more applicable title. Later observers have apparently demonstrated the tuberculous nature of the affection especially of the severer forms. Thus Jadassohn found in 19 cases 14 associated with tuberculosis, and only one case in which no such disease was present. He was of the opinion that the disease was non-bacillary, but that it was a disease of tuberculous persons. Of 16 cases treated with tuberculin 14 reacted typically, but although inoculations were made into guinea-pigs from nine of the cases, negative results followed. Kaposi believes that there is nothing to prove that lichen scrofulosorum is a manifestation of tuberculosis, although he asserts that tuberculosis is always present. In Tilbury Fox's six cases he noted the presence of tuberculous symptoms in the patients. Pellizzari succeeded in producing tuberculosis in a guinea-pig after the inoculation from one case.

Haushalter (1898) inoculated 4 guinea-pigs from 2 cases and they became infected with tuberculosis, one of the cases had an otitis media, the other a tuberculous lymph gland as

well as enlargement of other cervical glands. Some German dermatologists, e. g. Kromayer, Kaposi and Lukasiewicz, are opposed to the tubercular origin of this disease on account of the absence of caseation, the mildness of the affection and the rapid recovery. Only a very few cases have been recorded in France, and in those examined histologically no tubercle bacilli were ever demonstrated, although the subjects were tuberculous. It was believed, therefore, by the French dermatologists, Hallopeau, Brocq and Bureau that the lesions of lichen scrofulosorum were not due to direct infection but rather to the toxin of tuberculosis. Hallopeau reported one case which was associated with lupus. The lichen eruption was scattered chiefly over the trunk, but one group of papules was situated directly around the lupus nodule which had a scar in the center. In Lefebvre's case no bacilli were found in the sections, and the animal inoculation was negative. In both the cases recorded by Morris and Crocker tuberculous glands were present, but in Walker's case tuberculosis in any form was absent, neither was there any tuberculous history.

With reference to the American reports, only two cases have been exhibited at the meetings of Societies, and of these only clinical histories have been given. In all the cases recorded, the histological findings always show a likeness to those in tuberculosis, but in most instances after diligent search no bacilli have been found nor was the disease reproduced in guinea-pigs after inoculation. The inoculations, however, which have resulted successfully have demonstrated its tuberculous nature in those cases. My own case is a comparatively mild one and the presence of bacilli could not be demonstrated. Clinically it presents all the typical features of a lichen scrofulosorum as originally described by Hebra with the exception of the color, which would naturally differ in a negro's skin. Tilbury Fox called attention to the fact that instead of always appearing in groups, the papules may occur singly.

Sack in his descriptions and drawings shows that the papule is formed by the miliary tubercle being deposited directly beneath the epidermis and by some slight hyperkeratosis of the horny layer.

In my case the papules consist of distinct lesions involving the horny layer, and form, as it were, a dry pustule. It was neither clinically nor histologically a pustule, since it appeared to be made up of a homogeneous ground substance with masses of nuclear detritus and numerous pigment granules. There was no special hyperkeratosis. The tubercular nature of the disease was far from being pronounced histologically in the present case and the tubercles were situated around the lower portion of the hair follicle.

It is strange that a tubercular cutaneous eruption which yielded so readily to cod-liver oil should arise in a well-fed, healthy child with good hygienic surroundings and without previous history of tuberculosis. Clinically the case suggests the adoption of Hebra's title of lichen scrofulosorum or Unna's folliculitis scrofulosorum rather than tuberculosis follicularis. Since successful inoculations, however, have been made in at least three cases, then the latter title would be more correct.



FIG. I.—Photograph of a case of lichen scrofulosorum in a negro girl. The lesion can be best seen by using a hand magnifier as a small scaly papular eruption.



FIG. II. Shows a commencing papule (A) which is formed between the horny layer (H) and the mucous layers (M). Numerous polynuclear leucocytes (P) and lymphoid cells are emigrating through the epidermis to the horny layer. Two papillae (B) are filled with wandering cells and dilated vessels.

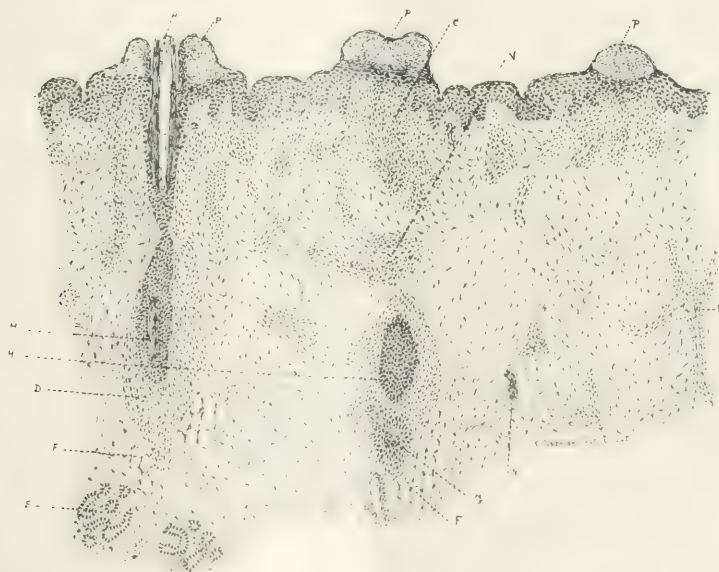


FIG. III. Shows three papules. The section has passed through the middle of two the section has passed through the middle of one. C, collection of lymphoid, plasma, and vessels; G, is a gutter; D, collection of cells; F, follicle; V, sweat gland.

P, P; one on the edge of a hair (H), on the other penetrating. H, H, are hair follicles. C, collection of lymphoid and polynuclear leucocytes. F, F, (follicle) the hair follicle. V, is (sweat gland).





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## A NEW INSTRUMENT FOR MEASURING HETEROPHORIA AND THE COMBINING POWER OF THE EYES.\*

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This evening I wish to describe a new instrument that I have recently devised for the estimation of certain functional disturbances in the extrinsic muscles of the eyes. The instrument is equally useful for testing both the heterophoria and the combining power of the eyes, but as one of its main features is that of a phorometer, I shall speak of it as a reflecting phorometer.

The instrument consists essentially of four mirrors, two for each eye, arranged one above the other and mounted in a rectangular frame so as to rotate on axes. The axes of the two upper mirrors are in the same line and are parallel to the horizon and perpendicular to the direction of sight. The axes of the lower mirrors are parallel to each other and lie in planes perpendicular to the horizon, and parallel to the direction of sight. The distance between the two lower axes is 6.25 cm. This distance may be greatly varied without having any material effect on the accuracy of the instrument, but the distance given was chosen as the most convenient one and closely approximates the average distance between the eyes.

The lower mirrors are made as large as possible without their interfering with one another. The upper mirrors are of the same size as the lower except perhaps a little longer. A good size for the lower mirrors is 3 cm. x 5.5 cm., and for the upper mirrors 4 cm. x 6 cm. In this model the axes of the upper mirrors are 5 cm. above the middle points of the axes of the lower mirrors, but this distance is unnecessarily great.

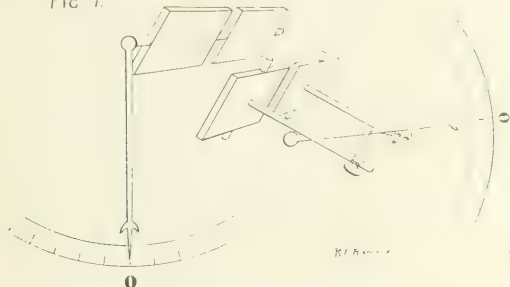
The axes of the lower mirrors are at an angle of 45 degrees to the perpendicular, but I think it would be better to reduce this angle as much as possible. The ideal way would be to have the axes perpendicular, but this is impossible since the lower mirrors would shut off the view from the upper ones. One of the upper mirrors is permanently set at an angle of 43 degrees to the perpendicular, while the other is freely movable about its axis, and to its outer end is attached a lever, 15 cm. in length, which is arranged to move along a scale and mark off the amount of rotation of the lever. Since the angle through which a mirror rotates is half the angular deflection produced in a ray striking it, the scale must be made so that one-half a degree of rotation of the mirror corresponds to one degree on the scale. The scale must be still further changed if it is desired to have it register prism-degrees.

To each of the lower mirrors a lever is firmly attached perpendicular to the axis at its middle point. These levers are each 8 cm. long, and at a point on each, 6½ cm. from the mirror, a small hole is drilled about the size of a canalic needle. Below this another, larger hole is drilled into which a key is fitted similar to those used on violins for tuning purposes. To a partition, placed midway between these levers, is attached another lever 14 cm. in length and pivoted at a point 3½ cm. directly behind a line joining the two levers and extending from the needle hole on one to the similar hole on the other. Three centimeters from the pivot of this middle lever a small hole is bored and a thread is then run through this hole by means of a needle and then continued through the holes of the other two levers. The thread is now connected with the keys on these levers and wound up until it is 3.1 cm. in length on each side. It must be firmly fastened

\* Read before the Johns Hopkins Hospital Medical Society, January 23, and before the Maryland Ophthalmological and Otolological Society, January 26, 1899.

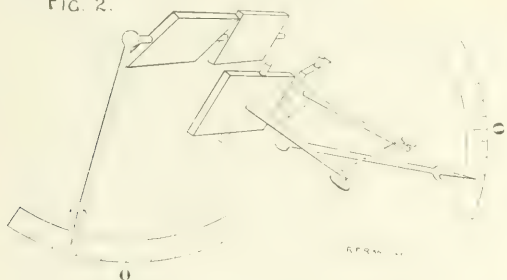
in the hole of the middle lever so that it will not slip. The thread is then made tense by means of rubber bands or helical springs attached to the levers and then to the sides of the frame. The object of the middle lever is to produce equal though opposite angular displacements in the two laterally moving levers.

FIG. 1.



A diagrammatic representation of the arrangement of the mirrors and levers is shown in Figs. 1 and 2. In Fig. 1, the two upper and the two lower mirrors are parallel and hence both scales register zero. In Fig. 2, one upper mirror is rotated to estimate hyperphoria or right sursumduction and the middle lever is depressed, tilting the two lower mirrors towards each other, to estimate exophoria or abduction.

FIG. 2.



A double level is fastened to the top of the instrument and the latter, resting upon a suitable stand (I have been using a camera tripod), is leveled and pointed at a small circular spot, distant twenty feet or more. To find the zero point for lateral displacement, one sights *over* one of the lower mirrors and then *through* this mirror and ascertains whether the image is in line with the object. If not, the middle lever should be moved up or down until this condition is obtained and then zero marked on the scale provided for the purpose. One must then sight over the other mirror in a similar manner, the adjustment being made this time however by the key attached to the lever of this mirror. A one-half degree prism is now held, base in, before one of the mirrors and the image as seen through both prism and mirror is put in line, by means of the middle lever, with the object as seen over them. One degree must now be marked upon the scale since there is a lateral displacement of one-half degree produced on

each side. Similarly a scale of degrees for both esophoria and exophoria is obtained. To obtain the zero point for the upper mirrors, the middle lever is pulled down until both images can be seen with one eye and they are then placed on a level by means of the lever attached to one of the upper mirrors. Another method is to put the middle lever at zero and then view a horizontal line with one eye, moving the lever attached to the upper mirror until the line is apparently continuous. By the use of prisms an empirical scale may be obtained by this method.

After the zero point for the lateral displacement is once obtained, it is an easy matter to readjust the instrument if the threads should break or stretch. All that is necessary is to place the middle lever at the zero mark and then turn the keys attached to the levers of the lower mirrors until the object is in line with the images seen through the mirrors.

It is important both in graduating and in using the instrument to have the object at the same height as the instrument and also directly in front of the latter.

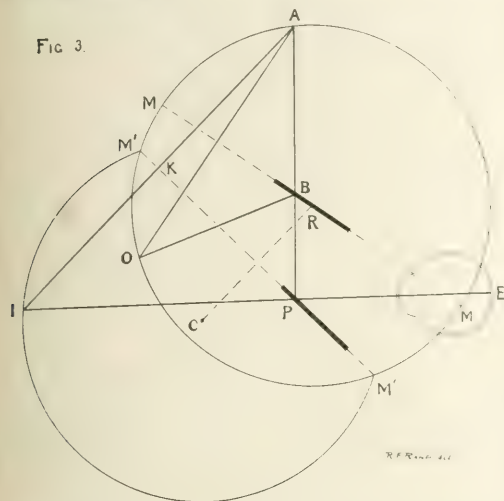
At the back of the instrument there is a door with two horizontal windows cut in it so as to correspond to the level of the eyes and their distance apart. On a pivot on the inside of the door is a shutter so arranged that when worked by means of a string it alternately closes one window and opens the other, one being always closed while the other is open. It would be very advantageous to have this shutter worked by some sort of clock-work arrangement.

To use the instrument, the patient is directed to sit down behind it, place his eyes on a level with the windows, and look through them at the circular spot, which, as has been said, should be at a distance of about twenty feet. The levers are then placed at zero on both dials and the shutter is moved to and fro at a moderate rate of speed. The patient is now asked to state whether the object seems to move or not. If not, his muscle balance is perfect. If he sees the object apparently moving obliquely, the outside lever, that is the lever attached to the upper mirror, is moved until the patient says the movement is horizontal and then the middle lever is adjusted until there is practically no movement. The outside lever will then register the amount of hyperphoria while the middle lever registers the amount of exophoria or esophoria, according as it is below or above the zero point.

If now it is desired to measure the relative adduction, abduction, or sursumduction of the eyes, that is the combining power of the eyes, the door at the back of the instrument is opened and the patient directed to look through the mirrors with both eyes. He will then see the object single, and without effort, since his heterophoria has been corrected by the previous adjustments. The middle lever is now depressed until the patient, by the greatest effort that he can make, is just able to fuse the images. The dial will then register the number of degrees of abduction. Similarly the amount of adduction and of right and left sursumduction may be obtained.

In addition to the test with the shutter, the amount of heterophoria may be estimated by this instrument in a manner similar to that adopted when prisms are used. To do this all that is necessary is to produce vertical or lateral dip-

lopi by the levers, and then move the proper lever until the images are in line. It is well to use this test as a confirmation of the shutter test.



The diagram, Fig. 3, is intended to illustrate in as simple a manner as possible the construction involved in locating the position of the image for each eye. The relations of object and mirrors to each other are exaggerated in order that the construction lines may be more plainly seen. The mirrors are in their primary positions, so that a line drawn perpendicular to the axes of the upper and lower mirrors will be perpendicular to the plane of the lower mirror.  $O$  is the object,  $M$  and  $M'$  the mirrors. From  $O$ , a line  $OA$  is so drawn that it is perpendicular to and bisected by the prolongation of  $M$ . Similarly from  $A$  the line  $AI$  is drawn perpendicular to and bisected by the prolongation of  $M'$  at  $K$ . All the rays from  $O$  striking  $M$  will be reflected in lines directed from  $A$  and these rays will be reflected from  $M'$ , in lines directed from  $I$ . Therefore an eye directed towards the mirror  $M'$ , will see the image of  $O$  at  $I$ . The actual path taken by a ray of light from  $O$  is indicated by the line  $OBPE$ . The locus of  $A$ , as  $M$  is rotated on its axis,  $R$ , is evidently the circumference of a circle whose radius is  $OR$ . The locus of  $I$  during this rotation is the circumference of a circle with the same radius but whose center is at  $C$ ,  $RC$  being drawn perpendicular to, and being bisected by, the prolongation of  $M'$ .

When  $M'$  is rotated on its axis, which lies in the plane of the construction, it is evident that  $I$  will move along the circumference of a circle perpendicular to the prolongation of  $M'$  and whose center is  $K$ . This circle being at an angle to the line of sight,  $I$  will apparently take an elliptical path.

From this it will be seen that when the middle lever is moved the image pertaining to each lower mirror moves in the circumference of a circle tilted at an angle of 45 degrees to the perpendicular and whose center is at the foot of the

perpendicular drawn from the object to the axis of the mirror. Since the projection of a circle is an ellipse, the image of each mirror will apparently move in an elliptical course, and will thus not only move laterally, but also upwards to a slight extent. This, of course, would seriously interfere with the accuracy of the instrument if each lower mirror were rotated independently, but by the arrangement previously described, both mirrors are made to move equally though in opposite directions and hence the images when viewed with both eyes maintain their horizontality.

If the test object is a perpendicular line its image will generate the surface of a cone and thus when projected the two images, as they are carried apart, will make increasing angles with each other. In this way a certain amount of rotation of the eyes on their principal axes could be measured, and with this model about eight actual degrees of such rotation can be determined. This method is entirely distinct from that just to be described.

The rotation of the eye on its principal axis is spoken of as torsion. Where this rotation remains constant I would suggest that the term torsional strabismus or squint be used. Where the eye has simply a tendency to rotate, the term cyclophoria has been suggested. These conditions may be accurately determined by the following arrangement: Two equal circular disks each having two perpendicular lines drawn through its center are placed one above the other so that one of the perpendicular lines in the upper disk is continuous with one of the lines in the lower. The upper disk is so made as to rotate upon its center when desired and degrees should be marked off upon the background to which it is attached. The lower disk should have its semi-circumference plainly marked off in degrees. The instrument is then pointed at the two disks and the hyperphoria lever so manipulated that the images of the two are exactly superimposed. The patient's esophoria or exophoria should be corrected by prisms.

To measure the amount of torsion the eyes are capable of undergoing, that is, the torsional combining power of the eyes, the upper disk is rotated until the lower or upper lines are beginning to be seen double and the number of degrees read off. To test the torsional squint, the upper disk is rotated until only two lines are seen and the number of degrees read off. To test the cyclophoria it is best to rotate the upper disk a definite number of degrees and then have the patient read off the number on the lower disk as he sees it, the difference between the patient's reading and the number of degrees the upper disk has been rotated will be the number of degrees of cyclophoria.

From a few experiments made upon myself and others, I am inclined to believe that normal eyes have little or no torsional combining power. In the few cases I have examined I have not found the slightest evidence of cyclophoria in the otherwise normal eye. Considering the disinclination of the normal eye to undergo torsion, it seems to me that if cyclophoria were present to any extent it would soon lead to torsional squint and produce amblyopia in one of the eyes.

A certain amount of angular displacement of the *vertical* lines may be produced without diplopia resulting, but this is



not overcome by rotation of the eye, however, as diplopia is almost immediately produced by the equal angular displacement of the *horizontal* lines. The phenomenon must be due, I think, to a psychical compensation, if I may be permitted to use such an expression.

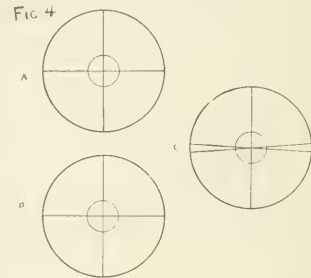
The reason this psychical compensation is so much greater for the perpendicular lines than for the horizontal is due, I think, to the fact that in viewing perspectives, the eyes have a stimulus to fuse non-corresponding points that are displaced laterally, while there is no call upon them to fuse perpendicular displacements, the eyes being always upon the same plane with regard to each other.

In this connection I quote the following from G. T. Stevens\*: "It is an interesting as well as an important practical fact, and one to which little attention has been given, that horizontal lines cannot be held in union while being rotated from the horizontal direction to an extent nearly equal to that in which vertical lines can be held in union. If vertical lines can be held in union with a rotation of 20 degrees or more, horizontal lines become double with a total rotation for both tubes of from 6 to 8 degrees. Indeed, it requires some practice to hold the lines in union with a rotation of each tube either out or in to the extent of 3 degrees."

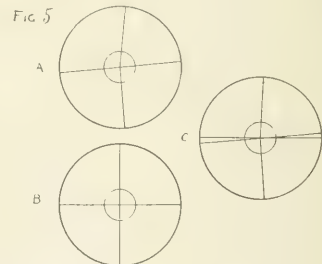
Stevens made his observations by means of an instrument which he calls the Clinoscope. This instrument enables him to superimpose various figures. The observation just quoted was made by superimposing two straight lines only. Stevens believes the phenomenon is due to differences in torsion, for he says: "A very considerable latitude is permitted in respect to the position of the vertical lines and the torsional act may overcome an important normal deviation." My experiments, however, lead me to believe that what Stevens has been studying is not the amount of torsion, but the variations in the psychical compensation for the different meridians of the eye. I have found that the greatest angle of separation of the lines at which they may still be fused, depends to a certain extent upon their length or what is just the same thing, upon the distance at which they are observed; the greater the distance, the greater the angular displacement allowed. This could not be the case if the phenomenon were due to torsion. On the other hand, if due to a psychical compensation for non-corresponding points, the increase in the angle with the increase in the distance would be expected, since the extremities of the lines would have to be placed farther apart in order for the extremities of their retinal images to be the same distance apart as before the increase in distance.

Another observation that I have made seems to prove conclusively that it is not by undergoing torsion that the eyes combine lines which are placed at an angle to each other. This observation was made by having the upper part of the vertical line on one disk separate from its lower part so that it could be put at an angle to the latter. If the upper part is rotated it will be seen that the line is no longer continuous, but consists of two radii of the disk placed at an angle. This line is readily fused with the vertical line on the other disk even when its two parts are at an angle of more than 10

degrees. It is inconceivable that such a line could be combined with a straight line by a process of torsion, since at least one of the eyes would have to rotate in two opposite directions at one time, but the assumption of the existence of a psychical compensation explains the phenomenon here just as satisfactorily as when both verticals are straight lines.



In Fig. 4 the upper disk, *A*, has been rotated 8 degrees, while the lower disk, *B*, is in the primary position. *C* represents the appearance presented to the eyes when *A* and *B* are superimposed. In Fig 5 the upper and lower parts of the vertical on *A* have each been placed at an angle of 5 degrees to the perpendicular, and are thus at an angle of 10 degrees to each other. The horizontal line remains perpendicular to the lower part of the vertical line and hence has been rotated 5 degrees. *C* shows the appearance when *A* and *B* are superimposed. It will be noticed that the angle between the two parts of the displaced vertical line on *C*, is less than the corresponding angle on *A*.



In the proper use of the reflecting phorometer the shape of the object to be viewed is of very great importance. As mentioned above, when the images are displaced laterally they are also inclined towards or away from each other and consequently it would be impossible to combine them if the object were a line, unless the eye underwent torsion. This, I find, it refuses to do, and it is necessary to adopt a plan to overcome the difficulty. Practically I have found that the images of a small circular spot about  $3\frac{1}{2}$  mm. in diameter are readily combined. As a matter of fact, the images of the round spot when lateral separation is produced are converted into ellipses whose axes are inclined to one another, just as in the case of the straight line, but there does not seem to be

\* Archives of Ophthalmology, Vol. XXVI, pg. 201.

enough difference in the images to interfere with perfect fusion. Theoretically a sphere should be employed as the object, for no matter how rotated its projection would be a circle. If used, however, it must be evenly illuminated, otherwise the shading would defeat the purpose in view. Lighted candles, of course, cannot be employed. The best arrangement is, either a small white circular spot on a black background of good size, or a lamp with a round window.

The number of degrees the hyperphoria lever moves is almost exactly half the number of degrees of the vertical displacement of the images. It is not exactly half, however, because the circumference which measures the angle made by the moving image, has for a center a point a little in front of the eye. (Fig. 3, *C*). But at a distance of 20 feet this error is not appreciable, and even if it were the dial could be graduated empirically. The closer the mirrors are together and the nearer the eye is held to them the less is the error. For the near point, however, the error becomes considerable, and if it is desired to test hyperphoria for the near point a special scale is necessary.

In a theoretically more perfect instrument, it would be necessary to have both the lateral and vertical movements produced by the lower mirrors. This would entail, however, a more complicated mechanism, and I think it is hardly demanded. In this model only one of the upper mirrors is moved. It would be better, however, to have them so arranged that they would move equally but in opposite directions. This is so, because if the lower mirrors be tilted for a high degree of lateral displacement, the moving of one upper mirror would produce a movement of the image along an oblique line instead of a vertical one and hence diminish or increase the reading. This error is very slight, however, and diminishes directly with the amount of lateral displacement.

The center of the curve along which the lateral movement of each image is made, is, for practical purposes, at the intersection of the line of sight with the axis of the lower mirror. Since the eye is a short distance behind this point, the lateral movement for near objects is perceptibly less than that registered by the instrument. It is thus necessary to make a scale for the near point and on this model I have done so, taking as the near point an object whose image is 30 cm. from the eye. The method of obtaining the scale must be modified from that adopted for the 20 ft. scale, since the image is about as far back of the real object as the distance between the upper and lower mirrors. The difficulty is overcome by having an upright line at this distance behind the object and in making the scale the image is adjusted with regard to this line and not with regard to the object.

The range of this model is from 10 degrees of exophoria to 15 degrees of esophoria. If additional range is required all that is necessary is to add prisms to the cells at the back provided for the purpose. Thus if a 5-degree prism, base-out, were added before each eye, the range obtained would be from 0 degrees to 25 degrees esophoria, and if base in, from 5 degrees esophoria to 20 degrees exophoria.

There may be some objections raised to the use of the thread in this instrument. I must admit that it does seem rather reckless to have the accuracy of the instrument hang on a

thread, as it were, but the little likelihood of the thread being broken and the ease with which a new thread can be inserted and the instrument readjusted, I think fully warrant its use. Other mechanisms could be devised for the purpose, but I think they would not increase the accuracy of the instrument to any extent.

The advantages of the instrument are obvious. Even without the use of the shutter mechanism it has the same advantage that Stevens' phorometer has over the ordinary prism test. This lies in the evenness and rapidity with which the reading may be obtained. In Stevens' phorometer, it is necessary to separate the images primarily at a distance equal to the limit of the instrument, that is about 10 degrees, and they are farthest apart when the heterophoria is least, and therefore most difficult to estimate. I think this is a decided disadvantage, for one image is on the fovea while the other is on a less sensitive portion of the retina, and it is consequently not only more difficult for the patient to estimate their relative positions, but he is likely to overlook or suppress one image entirely. In the reflecting phorometer, on the other hand, the images need be separated only so far as to produce constant diplopia.

Moreover, such difficulties are entirely overcome by the use of the shutter previously described. By means of this it is possible to locate the images upon corresponding points, in fact upon the foveas of both eyes. The very slightest heterophoria is thus detected at once, the image apparently moving in one direction or another, and when the apparent movement is overcome by moving the levers, not only the esophoria or exophoria is indicated on the scale, but the amount of hyperphoria as well. I have not tested the instrument with cases of amblyopia, but it is extremely likely that it will prove of the greatest value in just such cases, since the patient is seeing with only one eye at a time and hence has little tendency to suppress either image.

In testing the strength, or really the combining power, of the eye muscles, the instrument has very decided advantages. Ordinarily in testing the combining power of the muscles, first one prism and then another is placed before the patient's eyes until a strength is reached which the patient cannot overcome and diplopia is produced. The objection to this method is that the patient is tired out by having to overcome prisms so many successive times, and one can never be sure that he is not suppressing one image. With this instrument, however, separation of the images is gradually, though quickly, produced by the proper lever, and when the patient says the images are slipping apart the result is read off on the scale. This occupies no more time than it takes to read it.

Another very important use to which the instrument can be put is to give gymnastic exercise to the eye muscles. By moving the lever, the patient himself can do this, not by jerks as with prisms, but smoothly, and I find that it is possible for the eye muscles to abduct, adduct, or sursumduct to a greater extent than with prisms and that it is not so fatiguing to the eyes. By the use of this instrument I have no doubt that exercise of the muscles of the eyes will produce more satisfactory results than have hitherto been generally claimed for it.

I wish to express my great obligations to Mr. R. F. Rand for the very careful drawings he has made for me, and to Dr. James Bordley, Jr., for looking over the literature. So far as he has gone, Dr. Bordley has found no mention of any instrument at all similar to this one.

During a discussion following the reading of the above paper before the Maryland Ophthalmological and Otological Society, my attention was called by Dr. Hiram Woods to an article by Dr. Alexander Duane in the New York Medical Journal for August 3rd, 1889. In this article Dr. Duane describes a test for the insufficiencies of the ocular muscles that he calls the parallax test. The principle of this test, I find, is undoubtedly the same as that involved in the shutter test as described by me. "It consists of shifting the screen from one eye to the other and making the patient observe if the image moves, and if so, in what direction." Dr. Duane measures the amount of insufficiency by determining the prism required to overcome the movement in any one direction, and he claims that the test is an extremely delicate one, especially for hyperphoria. Dr. Duane evidently shifted the screen by hand, and it seems to me that if he obtained such excellent results in this rough way, the test, used in connection with

the reflecting phorometer in the way I have described, should prove of still more value.

I have given personal instructions regarding points necessary to the manufacture of the instruments to E. B. Meyrowitz, of New York, from whom in future they can be obtained.

#### DISCUSSION.

DR. THEOBALD.—I think Mr. Verhoeff has devised an instrument that is going to be of distinct value and one having decided practical merits. The shutter device, so far as I know, is entirely novel and very ingenious, and accomplishes exactly what is aimed at. The instrument combines with the qualities of the Stevens' phorometer the power to determine the ability of the muscles to fuse images; in other words, it gives the strength of the muscles in overcoming diplopia. At the same time it is simple and not likely to get out of order. I at first made the criticism that if one of its strings should be broken it would be difficult to get the instrument gauged again, but Mr. Verhoeff promptly threw it out of gear and in a few moments had it rearranged, showing that objection was not well founded.

I congratulate him upon having done such an excellent piece of work, and I think the oculists will consider it an instrument of great practical value.

## ON THE SOLUTION OF MERCURY IN THE BODY.

By ARTHUR SMITH CHITTENDEN.

(From the Pharmacological Laboratory of Johns Hopkins University.)

The apparently ready absorption of metallic mercury and its subsequent elimination in a soluble form has led numerous investigators to inquire into the action of the body juices upon the apparently insoluble metal.

That inunctions of finely divided mercury or the inhalation of the vapor can give rise to marked symptoms of mercurial poisoning has long been a matter of common knowledge. That this fact involves somewhere and somehow a solution of the metal is obvious; and the determination of the place and nature of this solution has held the attention of many investigators.

For some time it was supposed that the blood exercised an oxidizing influence on the metal; and although this belief obtains substantially to day among pharmacologists, yet the experiments which first led to this view have long been considered fallacious. For purposes of investigation the method of introducing mercury into the blood usually consisted in anointing either abraded or vesicated surfaces with quantities of mercurial ointment; animals were also compelled to inhale mercurial vapor. As a result of these experiments, soluble mercury was found in the blood, urine, and feces, and apparently, also in the form of metallic globules, in the depth of the epithelium and in the dejecta.

Oberbeck\* in a series of painstaking experiments found, upon

making microscopic sections of the area treated with mercurial ointment, that the corium was infiltrated with minute globules of the metal. After a similar inunction of vesicated surfaces, Zuelzer\* found the ducts of sebaceous glands as well as the sheaths of the hair follicles filled with the metallic globules.

In a paper some years previous to the foregoing, Hoffmann† obtained precisely opposite results in a series of similar experiments. It remained for Rindfleisch‡ to repeat these investigations and to determine the reason of the discrepancy in results.

After anointing an unabraded surface and cutting sections as described, he found that if he sectioned with the blade passing through the deeper tissues first and out through the skin, no globules of metal appeared in the corium and deeper structures; whereas, if he reversed the block and cut through the skin first, the mercury droplets could be made out in the depths of the tissue. In other words, the metal was carried into the tissues mechanically in sectioning.

In the experiments in which inunction on abraded surfaces was practiced and in which the insoluble metal was found in the internal organs, the lymphatic spaces and the capillaries were

\* Wein. Medicinal Halle, 1864.

† Hoffmann, Inaug. Diss. Würzburg, 1854.

‡ Rindfleisch, Arch. f. Dermat. u. Syph., 1870.

\* Oberbeck, Mercur. u. Syphilis. Berlin, 1861.



doubtless opened and the metal was picked up by the circulation.

The appearance of metallic globules in the faces of dogs which have been anointed with mercurial ointment may also be explained by the fact that unless the ears alone be treated, it is almost impossible to prevent the animal from licking off and swallowing the mercury.

According to Hermann,\* generally speaking, metallic mercury cannot as such pass through the intact epithelium in any part of the body. This is true of the respiratory epithelium as well as of any other. In cases where the mercurial vapor is inhaled, the metal is found condensed upon the surface of the epithelium, no globules passing beneath the surface unless they enter by some break in its continuity. Still other investigators, such as Hoffmann, Röhrig, Bärensprung, Neumann and Fleischer concur in this opinion.

If, then, in inhalation and inunction experiments insoluble mercury does not pass through the intact skin to be acted upon by the circulating fluids of the body, but does appear in soluble form in the blood and dejecta, what are the factors effecting solution? They may be found in two situations: in the secretions on the surface and in the menstium of the ointment. That the secretions of the skin contain materials which will effect the solution of mercury has been sufficiently proven. Lewald has shown that by treating mercury with ammonium butyrate, a component of the secretion of the skin, solution follows; moreover, the sebaceous secretion contains various other agents capable of acting in this way.

When mercury is precipitated on the respiratory epithelium in inhalation experiments, Hermann† says that, aside from the oxidation processes which might be effected by the air in passing over these surfaces, we must suppose some supplementary oxidation as a result of the activities of the tissue juices. This is borne out by the researches of Rindfleisch‡ wherein he finds, after introducing blue ointment into the conjunctival sac and suturing the eyelids, that, although inflammation has occurred and pus has formed, subsequent section of the eye in glycerine fails to reveal any metallic globules.

The questionable methods of experimentation and the wide discrepancy in the results of investigation lead Schmiedeberg§ to cast serious doubt upon the power of the blood to oxidize mercury.

The possibility that the various investigators referred to may have unwittingly introduced soluble mercury and therefore obtained positive results is apparent, and it was with this contingency in mind that Fürbringer|| devised a method calculated to eliminate experimental errors.

Having rubbed up definite amounts of mercury with gum arabic and glycerine, he obtained a dark-gray emulsion from which the larger globules separated out on standing: the remaining globules were exceedingly fine and remained in sus-

pension. In the supernatant liquid Fürbringer found only very minute amounts of mercury; this emulsion he injected into the femoral veins of dogs. After a definite time, varying from twelve hours to seven days, he drew off and immediately defibrinated the blood. Having allowed the blood to stand until the corpuscles had settled to the bottom, the serum was decanted off and the organic matter destroyed by oxidation with HCl and KClO<sub>2</sub>; the resulting solution was then submitted to electrolysis and positive evidence obtained in a number of experiments of the presence of soluble mercury.

In five experiments in which the animals were killed respectively, one, two, three, five and six days after injections, the chemical manipulations afforded plain evidence of the presence of mercury in the form of mercuric iodide rings. In four experiments no mercuric iodide whatever could be detected, and in three further instances the presence of mercury was questionable, as it could not be asserted positively that mercuric iodide was obtained.

Fürbringer's work is open to criticism in two particulars. In the first place, it is possible that a soluble compound is formed when mercury is rubbed in a mortar with solutions of gum arabic. Here, certainly, we have an exposure of finely divided mercury to oxygen, organic substances and to salts of potassium, calcium and magnesium. That it is possible for a soluble compound to be formed under these circumstances, Fürbringer admits; for, when his emulsions were allowed to stand for a long time in loosely stoppered vessels, a soluble mercurial compound, presumably mercurous mucate, was obtained. This possibility is further strengthened by the experiments of many investigators which show that when mercury is shaken with fluids containing salts and proteids a small amount of a soluble mercurial salt is formed.

A second criticism is that, oxidation of blood serum with HCl and KClO<sub>2</sub> will make soluble any metallic mercury which may be in suspension in the serum.

In justice to Fürbringer it must, however, be stated that he attempted by means of control experiments to show that he had not introduced soluble mercury into his animals and that the operation of defibrinating the blood and the subsequent chemical manipulations could not account for the mercury found in those of his experiments which yielded positive results.

Bearing in mind the criticism made upon previous investigations of this character, it is the object of this paper to present a method which shall, in so far as may be, eliminate questionable details of experimentation.

I have chosen the urine and faces as the objects of investigation because they seemed to present the least possibilities of error; in so doing, the dangers of oxidation and contamination of the mercury by salts and fatty acids of the skin are avoided.

#### METHOD OF PREPARING AND INJECTING THE MERCURY.

An alcoholic solution of mercuric chloride was treated with stannous chloride until all the mercury was precipitated in a finely divided form; this was filtered and washed with hot water until the filtrate gave no precipitate with silver chloride. The residue on the filter paper was then suspended in a physi-

\* Hermann, *Toxikologie*, Berlin, 1874. Also Harnack, *Arzneimittellehre*. Leipzig, 1883.

† Loc. cit. Also Harnack, loc. cit.

‡ Loc. cit.

§ Schmiedeberg, *Arzneimittellehre*, Leipzig, 1895.

|| Fürbringer, *Virch. Arch.*, 1880, Bd. 62.

ological salt solution; when examined under the microscope this suspension showed the presence of globules of mercury which were smaller than a red-blood corpuscle.

Having dissected out the femoral artery and clamped it centrally, about 5 ccm. of this suspension, containing approximately 0.25 g. of metallic mercury, was injected peripherally into the artery of each of four dogs.

The needle was withdrawn and in each case the clamp removed and the wound closed by deep and subcutaneous sutures. By thus deeply burying the artery the possibility of hemorrhage or of the animal licking up mercury was obviated. The urine and fæces of these animals were collected for a period of six weeks after the injection and analyzed for mercury.

#### METHOD OF DETECTING THE MERCURY IN THE URINE AND FÆCES.

For the method of detecting and determining the mercury in the urine and fæces I am indebted to Winternitz\* I constructed a system of three upright glass tubes each of which connected with a common T-tube and contained a roll of pure copper gauze 20 cm. in length. The urine was collected from time to time, filtered, acidulated to 1 per cent. with HCl and passed over the copper rolls through the uppermost arm of the T-tubes.

Each day's urine passed through this system six times and the collecting was continued for six weeks. The rolls of copper gauze were then withdrawn from the tubing, washed with water, alcohol and ether and submitted to a high temperature in the combustion furnace for one hour.

In glowing the copper rolls, a bayonet tube was used which contained beyond the rolls of gauze a layer of copper oxide and a spiral of silver wire separated by suitable asbestos plugs. In the straight end of the tube which projected from the furnace a small bulb was blown and in this were placed leaves of gold foil.

During the heating a stream of dry carbon dioxide was passed continuously through the tube from the bayonet extremity; at the end of an hour a large number of minute globules of mercury could be clearly seen on the sides of the tube as it projected from the furnace and in the bulb; also an amalgam had formed upon the gold foil. These globules could be rolled together into larger ones and gave red crystals of mercuric iodide when subjected to vapors of iodine.

To determine the mercury in the collected fæces, these were extracted for several days with water, the filtrate acidulated and passed over another series of copper rolls; the heating of the rolls was then carried out as in the urinary determination but failed to reveal any mercury in the form of visible globules. When, however, the tube and bulb were subjected to iodine vapor, plain evidence of a ring of mercuric iodide was obtained. The amount of soluble mercury present in the fæces was very minute as compared with that in the urine. This is hardly contrary to what might be expected, since secretion of mercury in the bile is slow† and the reabsorption in the intestine is

rapid.\* Furthermore, my method would not detect the mercury present in the fæces in the form of a sulphide. The total amount of mercury injected into the four animals was approximately one gramme; the amount recovered from the urine was estimated to be about 20 mg. That the amount recovered should be small is borne out by the researches of Lewin† who finds that after inunctions with blue ointment, mercury continues to appear in the urine for eight months.

The finely divided mercury used in these experiments was freshly prepared for each animal in order to eliminate any possibility of oxidation on standing.

That finely divided mercury could have been excreted as such by the epithelium of the urinary tubules would hardly seem probable inasmuch as repeated microscopical examination failed to reveal the presence of any globules either in the lumen or in the epithelial cells themselves.

Fürbringer speaks of the formation of thrombi during his experiments at the point where the cannula was introduced into the vein; other observers have mentioned emboli in the lungs. By injecting into the femoral artery it was sought to have the emboli form peripheral wards. Having killed one of the animals used in the experiments, I examined microscopic sections of the paw of the leg injected and failed to find any emboli. When Prof. W. H. Welch examined sections of the lymph glands which were submitted to him he made the following interesting observation: Scattered among the lymphoid cells were numerous large multinuclear megalokaryocytes, a condition resulting from parenchymatous‡ embolism of the bone marrow; these cells are subsequently expelled into the circulation from which they are filtered out by the lymphoid tissue.

The appearance of these cells in the lungs has also been observed in animals in which embolism of the bones had been produced.

Just how the solution of mercury by the body juices is effected and what part is played by the albuminous constituents, we cannot say, but that solution is effected and the mercury eliminated as an albuminate§ seems to be true.

Van der Does|| finds that after shaking dilute egg albumen with finely-divided silver and then filtering, the filtrate is no longer coagulable by heat; the albumen thus treated will not decompose when exposed to air, and that silver has gone into solution. Albumen treated in this manner with mercury does not give a similar result.

\* Real encyclopädie des gesammten Heilkunde, Bd. XVI, p. 317.

† Lewin, loc. cit.

‡ Lubarsch, Fortschr. d. Med., 1893, II, p. 805. Maximow, Virch. Arch., 1898, CLI, p. 297.

§ Real encyclopädie der Gesammten Heilkunde, loc. cit.

|| Hoppe-Seyler's Zeitschrift f. Physiol. Chemie, XXIV, p. 351.

#### THE JOHNS HOPKINS HOSPITAL BULLETIN.

The Hospital Bulletin contains announcements of courses of lectures, programmes of clinical and pathological study, details of hospital and dispensary practice, abstracts of papers read and other proceedings of the Medical Society of the Hospital, reports of lectures, and other matters of general interest in connection with the work of the Hospital. It is issued monthly.

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\* Winternitz, Arch. f. Exp. Path. u. Pharm., Bd. 25, p. 225.

† Lewin, Toxikologie II Auf., 1897, p. 116.



## PROCEEDINGS OF SOCIETIES.

## THE JOHNS HOPKINS HOSPITAL MEDICAL SOCIETY.

*Monday, January 9, 1899.***Exhibition of Medical Cases.—Dr. FLETCHER.**

During the fall of 1898, Lancereaux, of Paris, published a new method of treating aneurisms. He published the first communication, in connection with Paulesco, about the 1st of October and the method is as follows:

He injects into the subcutaneous tissue of the thigh 250 cc. of a 2 per cent. solution of gelatin in normal salt solution. Of course, it is thoroughly sterilized and injections are made with aseptic precautions. The injections should always be made at a considerable distance from the aneurism, and he considers the most satisfactory place to be the subcutaneous tissue of the thigh. The interval between injections should be from two to fifteen days. He states that about 20 injections are necessary to produce a cure, and from a considerable series of cases in which he has adopted this treatment quite a large percentage are reported as cured. He finds, however, that ordinary diffuse dilatations of the arch of the aorta are not relieved by the treatment, but that the most satisfactory cases are the saccular dilatations of the aorta, or of any of the other vessels.

Huchard, also, used this method of treatment, but recommends that a weaker solution than the 2 per cent. be used. He found that after the injections were given a great deal of pain was complained of for several hours at the seat of injection, so he recommends the use of a 1 per cent. solution, which apparently causes no pain. He reported two cases in which death occurred; one was a case of pulmonary tuberculosis, in which he believed the hæmoptysis was due to minute aneurisms on the small vessels crossing the pulmonary excavations. This patient died rather suddenly during the treatment. The second case was one under the care of Dr. Barth, and, in this instance, the patient after the sixth injection had a sudden attack of dyspnoea, suffocation, and died in a few minutes. An autopsy showed definite clotting in the aneurismal sac; there was a layer of fibrin about 4 cm. thick all over the wall of the sac, but the clots had extended into all the vessels, excepting the left subclavian, springing from the arch of the aorta, completely occluding them, and causing sudden death.

The beneficial effect of the treatment is supposed to be due to increased coagulability of the blood. Intra-peritoneal injections have been made in the rabbit by Lancereaux, and he believed that the coagulability of the blood was always increased. However, the adoption of this mode of treatment of aneurism has led to a great deal of discussion before the Academy of Medicine, in Paris, and various observers claim that the coagulability of the blood is not increased. Laborde claims that it is not, and says that gelatin is not absorbed when injected into the peritoneal cavity, and that he has found the same amount of gelatin several hours after injection, as was originally given. He states that possibly eventually it may be absorbed, and if so, it is because it undergoes peptonization. Laborde recommends that the gelatin injections be made into the sac itself. Camus and Gley have performed experiments

and found that there is no increase in the coagulability of the blood after intra-peritoneal injections of gelatin in rabbits—that is, there is no diminution in the time required for coagulation to take place.

We have now tried the treatment in four cases of aneurism in the medical wards of the Johns Hopkins Hospital.

The first was that of J. B., who was admitted about two months ago, with a definite sacular aneurism of the arch of the aorta about the junction of the transverse and descending portions of the arch, at least that is where we believed it to be during life. He had received six injections—two of the 2 per cent. solution, and four of the 1 per cent., because it was found that the first gave considerable pain. This pain was very intense and most severe about six hours after the injection. The patient appeared to be doing fairly well, when he was suddenly seized with an attack of dyspnoea, coughing and profuse hæmorrhage, and died. At the autopsy there was found a general dilatation of the arch of the aorta with a localized sacular dilatation about the junction of the transverse and descending portion of the arch. At the point of pressure of the sac on the left bronchus there had been a perforation causing hæmorrhage and death. There was no deposition of fibrin on the sac wall.

The second case in which the treatment was adopted was a patient, U. C., with aneurism of the descending portion of the thoracic aorta. He has now had 28 injections, more than the number supposed to be required to produce a cure. There was definite pulsation visible and palpable over the lower part of the thorax with a definite diastolic and systolic murmur in the back. There was intense pain at the seat of pulsation previous to the adoption of this treatment. Since the treatment was begun he has had very marked diminution in the amount of pain, and the pulsation is appreciably diminished. During the time of treatment he has gained 19 pounds in weight. It is the most satisfactory case we have had, so far, out of the four.

The third case is that of O. G., who has a sacular abdominal aneurism. He has now had 16 injections, with little or no evident improvement. He still has a great deal of pain.

The fourth case, C. L., has had 24 injections for a rather diffuse dilatation of the arch of the aorta. In this case, and in that of U. C. and O. G., there has been a marked increase in the coagulability of the blood after each injection—that is, the time of coagulation was distinctly diminished. (Exhibiting cases.)

An interesting condition that has followed the injections in Case IV is the occurrence of localized tumors at the seat of infection in the abdominal wall. The injections were made here because we thought there might be less pain than that which followed injections in the thigh. The pain was not, however, much diminished. The day following the injection a nodule the size of a hickory-nut frequently developed, occasionally accompanied with an elevation of temperature. These nodules persist for eight or ten days and then gradually disappear.

In the second case the coagulation time averaged about three minutes for the first ten injections and afterwards became



much delayed, for a short period, requiring 17 minutes for coagulation to take place. What the explanation of this is I cannot say, for it has again come down to five minutes.

#### THE SCHOTT TREATMENT OF HEART DISEASE.

About two years ago Dr. Camac read a paper before this society describing fully this method of treatment. Last summer I had the opportunity, through the courtesy of Dr. Theodore Schott, of seeing the method as used at Bad Nauheim. The treatment consists of two factors: the giving of thermal saline and carbon dioxide baths and the use of carefully regulated muscular exercises. The constituents of the saline bath consist largely of sodium and calcium chloride and the temperature is about 93 degrees F. After a series of these baths the patient is given a series of the carbon dioxide baths. The effect of the bath treatment is believed to be due to a stimulation of the peripheral circulation, thus increasing the amount of blood in the skin and subcutaneous tissue and in this way relieving the heart.

The exercises are believed to have practically the same effect; the patients usually get the baths in the morning and the exercises in the afternoon. The baths are given first for about six minutes and the time gradually increased until the patients are allowed to remain in the bath for about eighteen minutes.

I saw a patient given his first bath. It was a case of myocarditis in which the heart was very large, much dilated and its action extremely weak. Before putting him in the bath the area of cardiac dullness was carefully mapped out on a piece of transparent paper, and after the bath the cardiac dullness was again percussed out, the first diagram was placed over the second by means of definitely located points and any change in the area of cardiac dullness was thus noted. It was remarkable in this case to see the change; there was fully a finger's breadth difference in the extent of dullness before and after the bath.

At first the diminution after the bath is not permanent, but eventually a gradual gain is made and a widely dilated heart may diminish to practically its normal size.

Efforts have been made to devise a means of giving these Schott baths in hospitals and other institutions, and Theodore Schott has given formulas according to which the various baths can be prepared and carbon dioxide generated. The usual method of preparing the latter has been to use hydrochloric acid and sodium bicarbonate. During the past year a firm in New York known as The Triton Company have devised a means of dispensing with the use of hydrochloric acid and recommend a simpler way of generating the gas. They have prepared boxes containing a package of sodium bicarbonate and cakes of sodium bi-sulphate, the gas being generated by the action of these two salts upon each other. In addition to the bicarbonate of soda five pounds of salt and varying quantities of calcium chloride should be first added to forty gallons of water in the bath. The sodium bicarbonate is then put into the water and the cakes of sodium bi-sulphate, of which there are eight, are placed about the patient as follows: Two beneath the shoulders, two at each side of the body, and

two under the knees. In two or three minutes there is a rapid generation of the gas and the patient may then be placed in the bath, where he remains a variable time, according to the stage of the treatment.

This patient with myocarditis has received the treatment here. He has had no rheumatism; has not been a heavy smoker, but a rather hard drinker, and it was found on physical examination that he had a much dilated heart, the point of maximum impulse being in the sixth interspace 12 cm. from the mid-sternal line, just before the first saline bath was given. His heart's action was very weak, the pulse very feeble and many of the beats not recorded at the radial pulse. Dr. Hastings was kind enough to make these charts, on which the red lines indicate the area of relative cardiac dullness before the bath, and the dotted lines that after the bath. The greatest width of relative cardiac dullness before the first bath was 12 cm., and after the bath 9 cm. With each succeeding bath the area of dullness gradually diminished and this chart represents the present area of relative cardiac dullness, which you see is markedly diminished. The apex beat is now in the 5th interspace 7.5 cm. outside the median line and the greatest breadth of relative cardiac dullness is only 7 cm. His condition is much improved and he goes about the wards with very little dyspnea.

Dr. WELCH.—Referring to the first cases, I should like to ask whether in the gelatin treatment for aneurism any attention has been paid to factors other than the coagulation time, particularly as to whether there is any increase in the number of platelets in the blood or any diminution in the red-blood corpuscles? I speak of this because the coagula in aneurism are not ordinary clots as they form outside of the body, but are genuine thrombi which consist in their inception of platelets, and it is difficult to bring the occurrence of these thrombi in the body into any definite relationship with the rapidity of coagulation of the blood. Many diseases like lobar pneumonia and acute rheumatism in which there is increased fibrin content are not so frequently associated with peripheral thrombi as are typhoid fever and certain anæmic and cachectic conditions in which the fibrin content is low. We cannot bring the appearance of coagulation in the living vessels into direct parallelism with the coagulability of the blood as ordinarily understood. There are indications suggesting a connection of these thrombi with the number of platelets in the blood. In chlorosis, for instance, the number of platelets is increased and peripheral thrombosis is a well-recognized complication, whereas in pernicious anæmia the number of platelets is diminished and thrombosis rarely, if ever, occurs. In hæmophilia there is sometimes total absence of platelets. There is much for the view that the number of platelets is an index of lowered resistance of red corpuscles. If, therefore, there is any evidence that the gelatin treatment favors the production of thrombi in aneurisms, it seems to me that some light may be thrown upon the explanation of this occurrence by the study not only of coagulation time and fibrin content, but also of the possible influence of the gelatine injections upon the resistance and number of the red corpuscles and the number of platelets.

**Aneurism of Aorta, Compressing and Rupturing Into Left Bronchus.**—DR. FLENNER.

Anatomical Diagnosis: Aneurism of the aorta, rupture into the left bronchus, hæmoptysis; aspiration of blood into the lungs; compression of left bronchus; slight bronchiectasis, and carnification of the lung; acute splenic tumor; slight chronic nephritis.

The pericardial sac does not contain an excess of fluid; both layers of the serous membrane are smooth. There projects into the summit of the sac a roundish tumor springing from the aorta, which is intimately united with the pulmonary artery. The heart was opened *in situ*. It was found that springing from the left lateral wall of the ascending portion of the aortic arch is a saccular aneurism projecting toward the left side. The projection into the pericardial sac is found to be due to an extension from this aneurism. The dilatation of the aorta begins 5½ cm. above the attachment of the aortic valves and, as will be seen, includes portions of the ascending, transverse and descending aorta. An opening which is approximately circular and measures 6½ cm. is situated on the left lateral side of the artery. This opening can be divided approximately into three segments; the first third springs from the ascending, the second from the transverse portion and the third, which is the shortest, from the descending portion of the arch. The depth of the sac is approximately 4 cm. The sac, as stated, extends to the left and pushes aside the upper lobe of the left lung to reach the pleural surface with which it is firmly united. Finally it comes to impinge on the left bronchus, and it has also grown together with the fibrous wall of this structure. The œsophagus also is pressed upon by that portion of the sac which has come to lie next it.

The entire main bronchus, from the bifurcation of the trachea to the first division in the hilus of the lung, is pressed upon by the sac of the aneurism. As a result the walls of the former are distinctly thinned and there is a marked lateral compression of the tube. The bronchus has been perforated just below bifurcation of the trachea at a point coinciding with the intercartilaginous tissue between the second and third rings. The mucous membrane covering the second ring is eroded, while that over the third is swollen and defective superficially. The membrane between the third and fourth rings is much attenuated and appears to be covered by nearly intact mucous membrane only. There are two small ruptures to be made out in this membrane, which might readily have been produced in the removal of the lungs and bronchi. The mucous membrane of the bronchus where it is freed from the recently coagulated blood which covers the surface is pale. The left lung is bound to the chest wall and to the pericardium and aneurism by old adhesions; the apex only is crepitant. The bronchi upon section show a moderate dilatation of the medium-sized tubes, while the lung substance is congested, dense and more or less airless, the consistence being increased. In this carnified and congested tissue there are scattered small whitish or grayish points, and from the surface a cloudy fluid can be expressed. Certain areas of the lungs present a grayish and slightly coal-pigmented aspect and are semi-translucent. The right lung is voluminous. There are moderate pleural adhesions, the anterior and superior half being bound to the

pericardium. Where free from adhesions to the chest walls and pleura it shows blotches of hæmorrhage and upon section there are present deep red areas corresponding to points of blood aspiration. The medium-sized bronchi are plugged with recent clots of blood. The trachea and larynx, except for the staining of mucosa, are free from coagula of blood.

The aorta is the seat of marked arterio-sclerosis with slight calcification. The sclerosis does not begin immediately above the valves in that it leaves the first part of the aorta clear for a distance of 5 cm.; the most marked sclerosis is in the transverse arch. The sclerosis is less marked again in the thoracic aorta and abdominal aorta where relatively few sclerotic patches occur. The sac of the aneurism is almost entirely free from clots; the coats of the artery are shown to be present everywhere, the inner coat presenting an irregular corrugated appearance. Fatty patches, a few elevated fibrous nodules and a number of calcified areas measuring several millimetres in diameter—these last showing a slaty pigmentation—occur in the sac of the aneurism. These slaty and calcified areas are, on section, found to agree with underlying and closely adherent, nearly black lymphatic glands. The coagula upon the wall consist merely of a recent granular deposit, not exceeding a millimetre in thickness and imperfectly covering the inner surface.

Bacteriological examination showed the lung, liver and kidneys to contain the bacillus lactis aerogenes. The lung and liver, spleen and kidneys gave the micrococcus lanceolatus. 0.3 cc. of a culture of the micrococcus injected into a mouse produced death from general septicæmia.

Miss Reed has kindly examined the sections from the case, the chief interest of which centres in the spleen and the left lung. The spleen shows in its substance, especially in the neighborhood of the capsule over the ventral surface, a number of hæmorrhages, some small and others larger, although the largest does not exceed 1 or 2 mm. in diameter. In a broad way two kinds of hæmorrhages may be distinguished, although the line of demarcation is not absolutely sharp. The larger ones consist of red-blood corpuscles chiefly, with probably a due proportion only, of white corpuscles; the smaller, infiltrating areas which may not certainly be hæmorrhages, but localized congested areas, show a less perfect preservation of the hæmoglobin and the number of leucocytes with irregular nuclei considerably increased. Among the leucocytes in these latter situations are cells, the protoplasm of which reacts in a manner peculiar to hæmoglobin, which contain single nuclei or nuclei undergoing fragmentation. Similar cells to these are found distributed throughout the pulp of the spleen and are probably relatively as numerous as in the congested or hæmorrhagic areas just mentioned. Sections stained by the Biondi-Herdenhain method seem to prove what these stained in methylene-blue and eosin indicated, that these cells are normoblasts. The contents of some of the larger branches of the splenic vein are red corpuscles, leucocytes, cells with spindle-shaped nuclei; the latter were not improbably endothelial cells, derived from the vessels, post mortem. Small thrombi consisting of platelets and of leucocytes are also found in dilated veins containing in addition red corpuscles and endothelial cells presumably desquamated. The mixture of leucocytes and



platelets form small islands within the lumen of the vessel. Capillary thrombi in the region of the small hemorrhages were not discovered. In sections stained by Weigert's fibrin method this element occurs in foci in the splenic pulp. Finally, a fairly large number of cells containing red corpuscles are present in the pulp.

The description of the lung is limited to the left lung. The bronchi are moderately dilated and contain mucus, fragments of red corpuscles, and more or less modified desquamated cells. The blood-vessels in the wall are swollen and the wall is infiltrated throughout with round cells, some of which present exquisitely reticulated nuclei, placed somewhat eccentrically, and resembling plasma cells. This infiltration is not limited to the wall of the bronchus but involves the connective tissue which includes in the same sheath the vein and the artery. The artery shows a new growth of tissue in the intima, which is young and cellular and not annular, but is developed especially on the side of the vessel next the bronchus. The irregular distribution of the new tissue in the intima is shown in a section which includes a branch of the artery, for the new tissue is developed almost exclusively on the side of the vessel, next to the bronchus and is very little present in the point of origin of the new branches. In the lung the new growth of tissue is in the pleura—in the interlobular and perivascular tissues especially. The alveolar walls, it is true, do show an increase in the immediate neighborhood of the perivascular infiltration, but at distances from this there is only a filling up of the alveoli with desquamated epithelial cells, serum, a few leucocytes and a minimal amount of fibrin. The greatest amount of fibrin is in the immediate vicinity of the largest and most infiltrated bronchus. Not a few of the desquamated epithelial cells contain blood-pigment, or coal-pigment, or red-blood corpuscles. In sections stained in alkaline methylene-blue and eosin there were short chains of cocci to be made out. Thrombi are wanting in the vessels in this organ.

The type of liver cirrhosis is syphilitic. Sections through the coarse fibrous band in this organ showed a dense sclerotic tissue containing numerous islands of liver substance and a moderate number of newly formed bile ducts. Some blood-pigment and partial obliteration of the smaller-sized arteries through an annular growth of connective tissue in the intima are also present. Gummata as such are not present in any of the sections examined. The kidney showed a marked degree of parenchymatous degeneration and a small amount of new connective tissue. The heart muscle exhibited a marked degree of fragmentation and segmentation of the myocardium. The type of fragmentation is that regarded by Mr. MacCallum as being preceded by degeneration (sarcolytic) of the affected fibres.

**Multiple Metastases From Pelvic Sarcoma.**—[See BULLETIN for April, 1899.]

**DR. FLEXNER.**—The case reported by Drs. MacCallum and Harris is interesting from several standpoints. The distribution of the metastases exhibits two modes of dissemination of tumor cells: (1) Blood-vascular and (2) lymph-vascular. The nodules in the lungs undoubtedly owe their development to the first-mentioned mode. This is rendered probable not only by the relations of the primary and secondary tumors,

but also from the fact that Dr. MacCallum succeeded in tracing the growth along the walls of the blood-vessels to the nodules situated especially in the pleura, and also found groups of tumor cells in blood-vessels in the lungs. The testicular growth is conceivably of blood-vascular origin, the tumor cells having passed through the lungs and gained access to the general circulation. I am, however, disposed to regard the invasion of the testes as having taken place through the lymphatics, from the pelvic growth, by means of retrograde transport—a phenomenon not so very infrequently met with under similar circumstances.

As Dr. Harris pointed out, the streptococcus in this instance was highly pathogenic, not only for human beings but also for mice, an observation that has interested us greatly, in that our experience has been that growths of streptococci from human autopsies do not usually exhibit striking pathogenicity for these small animals. The streptococcus infection in this case was doubtless an example of terminal infection. We have now encountered a number of instances of terminal bacterial infection in malignant tumors.

#### NOTES ON NEW BOOKS.

**The American Year Book of Medicine and Surgery.** Edited by GEORGE M. GOULD, M. D. (W. B. Saunders, Philadelphia, 1899.)

The standard of previous years has been kept up in this work. It contains 1032 pages of text and 70 pages of a complete index. In the preface Dr. Gould refers to the omission of the name of Dr. William Pepper from the list of contributors. His place has been taken by Dr. Stengel and Dr. Edsall. The editor draws attention to the increasing difficulty of the yearly task of selecting what articles shall be noted. In this connection the hope may again be expressed, that it might be possible to give the titles of the most important articles not referred to in the text. If space allowed this, it would be an addition to the value of the book. The extracts are well made and evidently combine a maximum of information in a minimum of space. Altogether Dr. Gould and his staff of editors are to be congratulated on the Year Book for 1898.

**Annual and Analytical Cyclopædia of Practical Medicine.** By CHARLES E. DE M. SAJOUS, M. D., and one hundred associate editors. Volume II. (The F. A. Davis Co., Publishers, Philadelphia.)

The second volume of this valuable cyclopædia covers the subjects from "Bromide of Ethyl to Diphtheria." It contains 607 pages of useful reading matter. The object of the editor has been not only to facilitate the labor of the practicing physician and to assist investigators and authors in their researches, but also to render clear, through contributions from men possessing special knowledge or unusual experience in a particular line, diseases which, owing to their complexity, are not generally understood. The high standard of work commenced in the first volume is here maintained. The second volume contains among others, excellent articles on "Cerebral Hemorrhage," by Dr. William Browning; "Cirrhosis of the Liver," by Professor Adams; "Cholera," by Professor Rubino; "Cholelithiasis," by Professor Graham; "Diabetes," by Professor Lépine; and "Diphtheria," by Drs. Northrup and Bovaird. The editor states in the preface, in reply to numerous inquiries, that he himself wrote the unsigned article on "Animal Extracts," which appeared in the first volume.



**Manual of Physiology, with Practical Exercises.** Third Edition. By G. N. STEWART, Ph. D., Professor Physiology, Western Reserve University. (Philadelphia: W. B. Saunders, 1898.)

The rapid appearance of successive editions of this conveniently sized manual is sufficient evidence of a continued demand among medical students for text-books of smaller compass than the well-known standard works.

The present author, unwilling to meet this demand with a more or less elementary account of the subject, succeeds in crowding into his books all its details and gains the desired reduction in size by conciseness and brevity of treatment. The book is accordingly replete with facts, and extremely suggestive to one who possesses a previous knowledge of the subject. But as the high degree of condensation is necessarily attended with a corresponding loss in clearness and intelligibility, it is at least questionable whether it is really suited to the needs of medical students.

The practical exercises which, at first glance, enhance the value of the book, occupy about one hundred pages out of a total of somewhat over eight hundred. But the conviction grows on one that the author might have utilized this space more profitably to the reader as well as himself, if it had been expended upon a fuller and more lucid exposition of the general text. The frequent cross references from text to exercises in itself seems an acknowledgment on the part of the author of the insufficiency of the former. After all, the exercises claim no special merit as far as the choice of experiments is concerned; quite a number of excellent laboratory manuals, such as Stirling's or Brodie's, amply provide for the students' needs in this direction, while their grouping under the several chapters with reference to the systematic course, to which the author calls attention in the preface, will hardly be expected to secure a similar arrangement in practice. That the latter is advantageous and desirable for many reasons goes without saying, but its actual attainment depends on more things than the position of the exercises in a manual.

The book otherwise possesses many admirable features. We need only mention the superior character of all that pertains to its mechanical make-up, the number and variety of its illustrations, and the extent to which the most recent advances in physiology have been appropriated and used throughout the volume. We are a little surprised to find in so crowded a book a long paragraph on the *Care of the teeth*, a sort of error in perspective which also crops out occasionally in passages in which a relatively unimportant point is spread over a number of pages, out of all proportion to its value and significance. The discussion of the "Rate of blood-flow" covers about nine pages while the "origin of urea" is disposed of in three pages. In the chapter on nutrition we also note the omission of Drechsel's theory of the formation of urea and the scanty treatment given to the inorganic compounds, some of which like Ca have lately acquired so much significance in the general economy of the body. A few minor errors, like the formula for uric acid on page 436, the reference to Fig. 143 on page 519, and the incorrect account of the Holmholtz arrangement of the induction coil should have been corrected in a revised edition.

G. P. D.

**The Peritoneum.** By BYRON ROBINSON, B. S., M. D. Part I: Histology and Physiology. 4°. Number of pages 405 (not including a bibliography of 162 pages). 247 illustrations. (Chicago: The W. T. Keener Co., 1897.)

This volume is the first of what the author evidently intends to be a series of books dealing completely with the subject of the peritoneum. He tells us that it "is the outcome of a half dozen years of personal labor in experiments in the peritoneum, in the study of its anatomy and in microscopical research. The labor of others have been consulted and credited." Indeed, so ready is the author to give credit to those who have aided him, he has

often, we fear, ascribed to other investigators much that they would not claim as their own.

Dr. Robinson has been anxious to follow the example of the illustrious John Hunter, by distinguishing himself in scientific studies of value to medicine. He has put his whole soul into the work. It is dedicated to his wife and professional associate, Dr. Lucy Waite. Each chapter is headed by quotations from general literature which have appealed to the author as particularly fit. Wordsworth and Dryden, Gibbon and Froude, Lord Bacon and Emerson have all served to inspire the author in his work. The chapter on the blood vessels, for instance, is headed by a quotation from Tennyson's Brook:

"Men may come and men may go, but I go on forever."

On the title-page the following is quoted from Schiller:

"To control a subject, to be its master, to concentrate upon it all that is absolutely necessary, demands, in truth, the powers of a giant, and is more difficult than one would think."

Eager to discover the secrets of the structure of the peritoneum, Dr. Robinson has been led into attempting the mastery of many subjects necessary for this work, histology, histological technique, physiology, pathology, comparative anatomy and the history of medicine. The result has been most remarkable, as the extracts given below will show.

The book is divided into chapters. "Owing to an attempt to make each chapter as complete as possible," says the author in the preface, "repetitions have been to a certain extent unavoidable." Indeed, the author has been so desirous of expressing in every paragraph and sentence the totality of his knowledge of the subject, that repetition might be found on every page were Dr. Robinson capable of expressing his ideas so accurately that they would appear to be quite the same when they are the second time transcribed. The titles are the only clues as to the specific nature of the various chapters.

The absolute disregard of logical order displayed by the author is the most remarkable thing about the book. This is indicated in the extracts quoted, but to be fully enjoyed must be sought in the original.

"Diligence and accuracy are the only merits which an historical writer may ascribe to himself."—Gibbon, heads the historical sketch with which the book opens. In the first paragraph the time of Erasistratus is given as from 340-280 B. C.; in the second paragraph that of Galen is given as 131-201 to 210 A. D. Then the author goes on to say, "Galen must have been in the possession of the writings of Erasistratus, for he noted the fact in regard to the lacteals of kids 150 years after the death of Erasistratus." Further on in the book the following account is given of the origin of the cell doctrine and of its application to the study of the peritoneum. It will not seem strange to state that the organ known as the peritoneum is composed of simple cells, when one recognizes the penetrating power of the microscope and the vigorous and far-reaching investigations of the nineteenth century" (p. 26). After a considerable discussion of the work on the cell of Schleiden, Schwann, Muller and Johannes Miller, to each of the last two of whom is given in different parts of the same paragraph the credit of popularizing Schwann's works (Johannes Mueller is evidently meant), the author goes on to say: "At this period of the world appeared the immortal Bichat, whom the French claim founded histology, by employing the discoveries of Schleiden in the plant cells and those of Schwann in the animal cells" (p. 26). It will, perhaps, be remembered that Bichat died in 1802, two years before the birth of Schleiden, and eight years before the birth of Schwann.

What has confused the historian is the fact that Bichat called the peritoneum a "cellular membrane," meaning, thereby, one containing areolar connective tissue, which, at his time, was commonly called cellular tissue. For any understanding of our modern cell concepts, the use of the microscope is necessary.

Bichat, owing to the imperfections which existed in the instrument while he lived, put little faith in the value of the microscope as a means of tissue study. Considering the work done of recent years in cytology, it is not uninteresting to read the concluding remarks of Dr. Robinson on this subject: "Finally, the last break in traditional thought was made by the celebrated Brecke, who stated that a nucleus was not necessary to any cell. We now have the final definition of a cell—that is, a mass of protoplasm" (p. 27). Brücke is here probably referred to. Brücke is celebrated for having been the first to suggest definitely ('61) the modern conception of ultra-cellular units ranking between the molecule and the cell.

"The peritoneal membrane," he tells us, "is not dissimilar to the skin, being of about equal area" (p. 14). In the discussion of the various elements composing the peritoneum, he tells us "Perhaps the most typical specimen to observe a connective tissue corpuscle is in the blood-vessel wall of the broad ligament of a gestating turtle." Among elements not before described, is the "elastic tissue cell." "The elastic cell is what gives to the peritoneum its peculiar quality of adaptation to environments. The elastic cell must belong to a certain extent to the endothelia, for which they are capable of extension and contraction to a wide degree. The elastic fibre, composed, of course, of cells, is produced, according to Ranvier, by fusion of small globules. The elastic cell is very abundant; it is associated with the genital organs and endows them with the wonderful power of changing their conditions and of returning to normal without loss of integrity" (p. 31-32).

Here we have a most curious example of the confusion of ideas of form and function, so characteristic of the author. He has evidently fused an idea of the elasticity of the endothelial cells, and an idea of the existence in the peritoneum of elastic fibres into the vague conception of elastic cells.

We have not space at our disposal to quote here at greater length the author's original descriptions of his anatomical findings.

As to the physiology, "especially will we be surprised to know that the peritoneum of the dead animal will absorb, for many hours after death, exactly similar to that of the living" (p. 35). "The physiology of the peritoneum must be looked for in the inter-endothelial space by its dilatation and contraction. The cover-plates are, perhaps, not engaged much in physiology (sic). The hard, indurated metamorphosed protoplasm of the cover-plate aids chiefly in a mechanical way to facilitate motion, when aided by the visceral fluid secreted through the inter-endothelial space. However, the cover-plate doubtless plays a rôle in osmosis. "The forces which are said to induce peritoneal absorption of fluids may be enumerated as follows: (a) Vital cell forces; (b) stomata; (c) imbibition; (d) filtration; (e) intra-abdominal mechanical pressure; (f) osmosis" (p. 394). "Through ages of evolutionary processes of infective invasion, the pelvic, appendicular and gall-bladder region (the region of the large intestine) has acquired a physiology which resists the infectious germs in the common regions of peritonitis" (p. 399).

Although the object of the present volume is to deal mainly with the normal histology and physiology of the peritoneum, the author does not hesitate to refer to his extensive clinical and pathological experience when this may aid in making clear his thought. "The peritoneal surface is equal in area to the skin, and when injured by traumatic processes or attacked by disease, shows similar effects, as profound shock, significant vascular disturbances and depressions. A square foot of peritoneum being inflamed shows similar disturbances as the inflammation of a square foot of skin. In the peritoneum the inflammation is not so apt to be circumscribed or limited as it is in the skin, and hence the more danger of sepsis. Sepsis may pass through the peritoneum and leave it, as a bullet leaves a gun-barrel, uninjured" (pp. 256-257). "When foreign bodies (microbes or colored granules) enter the peritoneum the leucocytes swarm out (a) to digest the invader, (b) to surround or imprison the microbe or (c) to sterilize the germ" (p. 289).

Of equal value are the author's researches in the comparative anatomy of the peritoneum. "In this work we have examined the peritoneum of man, horse, dog, sheep, cat, cow, pig, hen, woodpecker, shypoke, frog, turtle, rabbit, crawfish, dove, guinea-pig, rat, fish, and embryos of man and some other animals. The material has been ample, but it would have been desirable to examine the peritoneum of monkeys and other animals only obtainable by living in proximity to a menagerie, where one could examine systematically the various genera and species and note the differences. However, material has been sufficient to induce me to believe that the peritoneum of vertebrates is constructed so much alike that it is equally well to select two animals, as the rabbit and the frog (cheap and conveniently obtainable), and carefully interpret the phenomena of structures and function of their peritoneum. The endothelia of the fish are like those of mammals. The crawfish has relatively small-sized endothelia, and they are very compact" (p. 34). "This work has proved that the structure of the peritoneum of vertebrates and mammals is quite similar" (p. 23). "The turtle (amphibia, *sic*) is one of the best animals to show vast interstitial subperitoneal spaces" (p. 395).

Many of the illustrations taken from the literature, especially those from Kolosow's articles, are well reproduced. The great number of the drawings, made by the author himself, serve to adorn the text. The bibliography is as complete as one as money can buy.

Taking the book as a whole, it reminds us more strongly of the remarkable Syllabus of Ephraim Cutter on Clinical Morphologies, than any other book that we have seen, though the latter has the additional merit of better order and of much greater condensation. It may be remembered that Cutter names among other things in a long list of objects to be looked for when examining the sputum, the "lumina of blood-vessels," and apologizes for not adding to the list the difficult "morphology of the air." B.

The American Pocket Medical Dictionary. Edited by W. A. NEWMAN DORLAND, A. M., M. D. Containing the Pronunciation and Definition of over 26,000 of the terms used in medicine and the kindred sciences, along with over 60 extensive tables. (Philadelphia: W. B. Saunders, 1893.)

This is a handy little volume that, upon examination, seems to fairly fulfill the promise of its title, and to contain a vast amount of information in a very small space. It must be, of necessity, incomplete; but it is somewhat surprising that it contains so many of the rarer terms used in medicine as it does.

The principal criticism suggested, and this seems a little ungracious when so much is given in so small a compass, is that it might well have contained a few more of the modern synonyms of the nervous system, proposed by Dr. Wilder, than we find in it. These terms have already been employed in medical literature and are likely to be employed again, and their inclusion would have added to the value of the book.

The work is of rather convenient size, and is attractively gotten up.

Hay Fever and its Successful Treatment. By W. C. HALLOPETER, A. M., M. D. (Philadelphia: P. Blakiston, Son & Co., 1898.)

About two-thirds of this little volume is taken up with the history of hay fever, or, what amounts to the same thing, the discussion of its exciting and predisposing causes. Then come descriptions of the symptoms and theories of its pathology, etc., and about ten pages at the end of the work are devoted to the treatment. The author pins his faith upon a systematic course of daily atomizing, and swabbing the nasal and post-nasal mucosa with antiseptic solutions (Dobell's solution, well diluted, is recommended), with such general tonic measures and attention to the diet, habits, etc., as appear indicated in each individual case. Any existing



abnormal condition of the nasal passages is, of course, to be looked for and remedied if possible. In old cases, when the nerve habit of this disease has become established, he advises this treatment for several weeks before the expected onset of the attack, but does not apparently give the duration of the treatment, and it may be assumed that in some cases, at least, he would continue it through the whole hay fever period. It is to be inferred that by this method also, and indeed he expressly so states in his remarks on prognosis, he succeeds in time in breaking up the tendency and curing the patients in the majority of cases.

The book is clearly written and can be read comfortably at a sitting. A bibliography is appended that seems fairly full as regards recent American contributions.

**Diseases of the Eye.** A Hand-book of Ophthalmic Practice, for Students and Practitioners. By G. E. DE SCHWEINITZ, A. M., M. D., Professor of Ophthalmology in the Jefferson Medical College; Professor of Diseases of the Eye in the Philadelphia Polyclinic; Ophthalmic Surgeon to the Philadelphia Hospital; Ophthalmologist to the Orthopedic Hospital and Infirmary for Nervous Diseases. With 255 illustrations and two chromo-lithographic plates. Third edition, thoroughly revised. (Philadelphia: W. B. Saunders, 925 Walnut St., 1899.)

The fact that the publishers have found it necessary in so short a time to issue another edition of the work of this gifted ophthalmologist is strong evidence that the fruits of his labors are speaking positively and that the "Hand-book" has won its success by supplying, probably more fully than any other American text-book on this subject, the wants of students and practitioners.

The author is to be congratulated upon such a substantial tribute to the value of what he has done for ophthalmology in this country.

The first edition of Dr. de Schweinitz's book was widely and favorably criticised, and it is unnecessary here to review at length a third edition. We note that paragraphs on the following subjects have been added to this edition: Favus of the Eyelids, Blepharochalasis, Koch-Weeks' Bacillus Conjunctivitis (Acute contagious Conjunctivitis), Pneumococcus Conjunctivitis, Diplo-bacillus Conjunctivitis (subacute Conjunctivitis), Parinaud's Conjunctivitis, Pneumococcus Infection of the Cornea, Mixed (Staphylococci, Streptococci) Infection of the Cornea, Schizomycetel Infection of the Cornea, Oyster Shucker's Keratitis, Fugacious Periodic Epithelitis, Röntgen Rays for detecting foreign bodies in the Vitreous, Retinitis Striata, Hereditary Optic-nerve Atrophy, Eucaian and Holocain. While it is evident that the author is no advocate of the so-called mechanical theory of the origin of pannus (page 249), we think that he might have expressed his own views more positively with reference to this interesting process. The belief is gaining ground that pannus is the corneal manifestation of trachoma,—in other words, that it is an invasion of the cornea by the trachomatous process. The fact that the region of the upper lid is the seat of the intensest manifestations of trachoma is, we think, sufficient reason for the usual location of pannus, not because the granules are more marked in this region, but because the specific bacteria are probably there in greater numbers and purity than anywhere else in the conjunctiva, consequently the upper part of the cornea is peculiarly exposed to infection.

What the author says about the use of eserine in corneal ulcers (page 278) should be remembered, and we are in accord with him in thinking that atropine in such cases is the better drug,—indeed further than this, it has always seemed to us that eserine, on account of its use in glaucoma, deserves a very insignificant place in ocular therapeutics, and that so far as its use in corneal ulcers is concerned, the condition of irritation is far more apt to be heightened than ameliorated.

The author quotes Nettleship (page 308) as saying that episcle-ritis is more common in men than in women. We have found just the reverse, and so also have Meyer and Stellwag. It would be

interesting to know what the author's own experience has been in this connection.

It is not uncommon to hear students complaining of the great number of remedies and methods of treatment laid down in the text-books out of which a choice must be made. We think that the most effective and, in many respects, the safest teacher of ophthalmology to whom we have ever listened was one who was in the habit of delivering his opinions as axioms, who used very few drugs, and who rarely spent much time upon the rehearsal of other men's theories and suggestions. There is probably no science so rich in discarded theories and so hampered with worthless suggestions as medicine, and the text-book which banishes such material from its pages will be apt to leave the most lasting impression upon its readers.

The book which Dr. de Schweinitz has given us, we are gratified to see, bears throughout the mark of personal experience and is unusually free—except when essential—of "what others think." The chapters on diseases of the conjunctiva and iris (Chapters VI and IX) which are supremely important for students and practitioners are admirable, and did the limits of a review permit we might multiply examples of valuable observations and advice. We cannot close without calling attention to the accuracy and suggestiveness of the many illustrations (255), and to prophesy for this third edition of Dr. de Schweinitz's book no diminished measure of success.

R. L. R.

**The Care of the Baby.** A Manual for Mothers and Nurses. By J. P. CROZER GRIFFITH, M. D. (W. B. Saunders, Philadelphia, 1898.)

Although a manual for mothers and nurses, and not distinctly a work for the use of the practicing physician or one interested in the purely scientific side of the subject, the present volume contains so much excellent material, and is so admirably compiled, that it can be read with great advantage by any one who is interested in the care and proper bringing up of young children.

The book is written for the layman, or, rather for the lay woman, and for that reason the author has made use of a style and mode of writing which can be easily understood by her, and has avoided the many technical words and phrases which are so characteristic of the usual literature on this subject. This popular style, we think, will not only be of advantage to those for whom the book is especially designed, but has made the text such attractive reading that it is difficult to see how any one can take up the book without becoming interested in its contents.

The entire subject of the "Care of the Baby" has been most thoroughly taken up, and the author begins with a consideration of some points of importance to be observed by the mother and nurse during the latter part of pregnancy and labor. This is followed by chapters on the baby's growth, the baby's clothes, feeding the baby, exercise and training, the baby's nurses and rooms, and, finally, the sick baby.

There are so many excellent points throughout the entire volume that, in so short a review, it is almost impossible to give a just criticism. The section on feeding the baby is particularly good, and we are glad to see that the author has taken such a positive stand as to the duty of every mother to nurse her own child; and also that, in the consideration of the subject of artificial feeding, he has followed largely the rules laid down by Rotch, of Boston. In the sections on exercise and training, and the baby's nurses and rooms the mother will find many valuable hints on the proper hygienic management, care, and moral training of her offspring, the importance of which cannot be possibly overestimated.

The chapter on the sick baby has been treated under the following headings: I. The features of disease. II. The management of sick children, and III. The disorders of childhood. The first of these divisions, that on the features of disease, we think, the disadvantage of not being complete enough to be of value to the physician and probably too full and technical for the



mother, whose mind may be filled with so many apparent symptoms that she will be made very miserable by the slightest indisposition on the part of her child. It contrasts markedly with the section on the management of sick children, which deserves nothing but the highest commendation. Under the third section, on the disorders of childhood, a brief account is given of all diseases peculiar to that period of life, and especial stress laid on their nursing and management. The work is completed by a good appendix containing accurate directions and receipts for making various articles of diet and medicines and for giving baths, hot and cold packs, spongings, etc.

Dr. Griffith has avoided criticism by making the statement in his preface that "the chapter on the sick baby is not intended to supplant the physician, but is designed especially for mothers in emergency, where medical aid cannot be quickly obtained"; and in emphasizing the importance of this statement we feel that we are not doing wrong in recommending the book most highly to mothers, nurses, and physicians.

A Text-Book of Obstetrics. By BARTON COOKE HIRST, M. D., Professor of Obstetrics in the University of Pennsylvania. (Philadelphia: W. B. Saunders, 925 Walnut St., 1898.)

Professor Hirst is so very well known both as a practical obstetrician and a teacher of obstetrics that the title of this volume alone should be more than enough to assure its getting into the hands of the majority of specialists, general practitioners, and students of obstetrics throughout the country. The work is an admirable one in every sense of the word, concisely but comprehensively written, in a style which makes its reading more a matter of entertainment than the perusal of numerous dry facts and dogmatic statements, which is unfortunately so characteristic of many other books on this same subject. Frequent reference in the text has been made to the work of others, both in this country and abroad; but a laudable effort evidently has been made to avoid mentioning the long lists of names and the tedious recapitulation of literary productions, which, in the opinion of the author, only tend to confuse and to complicate matters for the student. Hence, only the epoch-making articles have been referred to.

The illustrations of the book are, for the most part, excellent, and although some of them cannot be said to come strictly into the category of art, yet they have the advantage of bringing out the points which the author wants them to show. Exceptions to this might be made, however, in the case of a few reproduced photomicrographs, which occur in the section on the placenta. Photomicrographs may be scientifically accurate from the purely optical standpoint, but it is so very rare that one sees the reproduction of one of these pictures showing what is claimed for it, that it is with considerable regret that we see them, however few, in a publication possessing so many other advantages.

The author has divided his subject into the following sections: Pregnancy, Physiology and Management of Labor, and the Puerperium, the Mechanism of Labor, the Pathology of Labor, Pathology of the Puerperium, Obstetric Operations and the New-born Child.

The section on pregnancy is, in the main, excellent, and offers no points for criticism, except that possibly enough stress has not been put upon the development of the fetal appendages; we do not mean by this that there should be anything like a full treatise on human embryology in this place; but the development of the placenta with its relation to the decidua and uterine wall is so important a subject that we think a little more space might have been allotted to it. The diseases of the fetal appendages, placenta, membranes, decidua, etc., are considered immediately after the question of their development. This is a new departure, for these subjects are, in the majority of text-books, given a section to

themselves, and put later in the volume. Their consideration, however, at this time and place may have distinct advantages, for, clinically, many of these conditions cannot be recognized until after labor, and when put under a separate heading, as is usually done, the student may get the idea that they are desperate diseases to be treated *per se*.

Too much credit cannot be given to the masterly manner in which the author has presented the subjects of the management of normal labor and the puerperal state, but it is difficult to see why these subjects should have been taken up before the mechanism of labor has been considered.

The treatise on pelvic contraction and deformity, and labor when complicated by such conditions, is an excellent one in every possible sense of the word. This section appeared a few years ago in the first edition of the American Text-Book of Obstetrics, and to those who are familiar with this work it needs no recommendation.

We are somewhat surprised that the author has not mentioned the importance of a bacteriological diagnosis, by means of the uterine culture, in puerperal infection, nor can we agree with him in thinking that in many cases the repeated, frequent douching of an infected uterus to be of value, for in our experience such cases are by no means the rule. He also advises the routine use of the curette; and strong (1-2000) bichloride intra-uterine douches; upon this point we must also confess that we are skeptical. In our opinion the treatment of puerperal infection and the determination as to whether we shall use the curette and douche are directly dependent upon the nature of the infection as indicated by the bacteriological findings in the uterine lochia. Except the above, the section on puerperal infection is good.

Operative obstetrics and the section on the care of the new-born child are both well worked up, though that on the new-born child is short and more might have been said on the subject of infant feeding.

## BOOKS RECEIVED.

*Nervous and Mental Diseases.* By A. Church, M. D., and F. Peterson, M. D. 1899. 8°. 843 pages. W. B. Saunders, Philadelphia.

*On Fractures and Dislocations.* By Professor Dr. H. Helferich. Translated from the third edition (1897) by J. Hutchinson, Jun., F. R. C. S. 1898. 8°. 162 pages. The New Sydenham Society, London.

*The Pathology and Treatment of Sexual Impotence.* By Victor G. Veeki, M. D. From the author's second German edition, revised and rewritten. 1899.. 8°. 291 pages. W. B. Saunders, Philadelphia.

*Transactions of the American Pediatric Society.* Tenth session, held in Cincinnati, June 1, 2 and 3, 1898. With an index of Vols. I to X. Edited by F. M. Crandall, M. D. Volume X. 1898. 8°. 226 + xii pages. Reprinted from The Archives of Pediatrics.

*American Pocket Medical Dictionary.* Edited by W. A. N. Dorland, A. M., M. D. 1898. 16°. 518 pages. W. B. Saunders, Philadelphia.

*Proceedings of the American Medico-Psychological Association at the Fifty-fourth Annual Meeting, held in St. Louis, May 10-13, 1898.* 8vo. 417 pages. Published by American Medico-Psychological Association.

*Annual Addresses of the President of the Medical Society of the District of Columbia.* Delivered 1894-95-96-97-98. By Samuel C. Busey, M. D., LL. D. 1899. 8vo. 178 pages. Washington, D. C.

*The British Guiana Medical Annual.* Tenth year of issue. Edited by W. S. Barnes, M. D., and J. F. S. Fowler, M. B. 1898. 8vo. 52 + xxxiii pages. Baldwin & Co., Georgetown, Demerara.

# BULLETIN

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## THE DUTIES AND THE DANGERS OF ORGANIZATION IN THE NURSING PROFESSION.\*

By GEORGE M. GOULD, M. D., of Philadelphia.

When I received the kind and honoring invitation of your committee to speak to you to-day I chanced to be chatting with a friend; I read the letter to him and asked him what I should do. His answer was a description of his personal efforts in behalf of nurses and their calling, efforts extending over many years, and most unselfishly carried on. The general effect was not encouraging to me. My friend could not see how he had done any good to others while he had sadly wasted his own time and life, to find at last that he had aroused only suspicion and had ended in resultlessness. When I came to ponder the matter I thought I had found the solution of my friend's pessimism in the fact of the needs, difficulties, and dangers of organization, and that in the swift historic uprising of your large body, these needs, difficulties and dangers must at first necessarily end in much confusion and disappointment. All human institutions reach a condition of stable equilibrium through manifold trials, and the trials should not deter us from adding our personal influence as one factor that may, or it is true, that may not have influence in determining or hastening progress. If our contribution is ineffective, we

must remember that in science a negative experiment is always of value. We must learn the "No thoroughfares" of life for the first time and before signs have been put up across them, by actually running against them and thus experimentally proving that there can be no advance in that direction. Moreover, some later Baron Haussmann of progress may be able to crash the Boulevard of Science straight through the obstruction that we, in our impotence, deemed insuperable.

I shall say but a passing word as to the need of organization,—and that consists only in the emphasis of its inevitableness. You find yourselves in a somewhat chaotic condition to-day so far as pertains either to social, national, international, or professional organizations. But in these times of a thousand kinds of "combines" and centralizations, there is no escaping the evolutionary fatality of union. I use the word "fatality" advisedly because I would at least hint by it my feeling that there are cruelties and dangers of many kinds almost inevitably connected with any very thorough organization,—not enough to make us refuse to join, but surely enough to make us cautious. Majorities are tyrants and democracies are as tyrannous as any other type of government. The very forces of cohesion which compel like units to bind themselves to solidarity and unity of purpose have an

\* An address to the Graduating Class of the Johns Hopkins Hospital School for Nurses, delivered June 2, 1899.

inherently fatal tendency to crush out the independence of the units and to reduce effort to a huge and ungovernable mechanicalism in which freedom is sacrificed to the attainment of object, and method is scorned for result. Up to now you illustrate none of this, and my warnings may seem very much like foolish croaking. I learn, indeed that your class is an instance of the good of organization, and with all my heart I congratulate you on the fact that the educational ideal has been uppermost in your three years of work, and that you have not been bribed and whipped to do an atrocious amount of slavish work for the benefit of some heartless institution, which pays you in a sheepskin, the significance of which lies in the knowledge fought for despite jaded bodies and minds. But the point of my croaking is that you compare the lots of many of your sisters in other training schools which demand so many hours a day of toil that the educational aspect is lost sight of, and is impossible for the weary ones. *There* you see the evil of organization.

In a calling like yours and, I may add, like mine—that of the nurse and the physician—the need of organization is most evident, and yet there is a strange waywardness, an unaccountable shyness which preserves freedom and individualism by an aloofness that serves at least as an excellent “governor” of the machine, and which keeps it from self-sacrifice to ultra-mechanicalism. For many years, in season and out of season, I have been pleading for a unitized medical profession and the dire consequences of our disorganization have never been more frightful than to-day. But none would be more prompt than I to delimit sharply the range of action of medical organizations, should they seek to tyrannize over the righteous freedom of the individual member.

In your calling and condition the duties and dangers of organization are greater than in almost any other. Among several reasons for this there is one that I trust you will pardon me for alluding to. I may do this the more freely because I have a hundred times urged the greatest liberality toward and encouragement of the desires of women for a wise equality of opportunity with men. But no such generosity need blind us to the fact that by nature woman in her uses of social power and organization is a “born tyrant.” In the purely personal relation she is grace divine, but whenever put in authority over others, and especially over other women, she usually manages to make herself as hateful and as well hated as human ingenuity will permit. It is, of course, not always so, and thank God for the blessed exceptions! In organizations of women, women must necessarily be officers, and of course majorities must rule. It strikes me therefore in selecting the officials of whatever organizations you may form, you should use your best endeavors effectually to squelch politicians and tyrants and to reward those who show *das Ewig-Weibliche*, the graciousness of justice, and the justice of graciousness, in the exercise of authority and power. In governing, for Heaven’s sake do not learn of us men only our faults while you assiduously forget both our virtue of justice and yours of love. The hardest duty you will have to learn is that of kindness and justice to minorities. Politically, the most tyrannous of human beings and the most enslaved is the American. Can you not manage it so in your treatment

of those who do not vote with the majority, that you do not march over their rights with the ruthlessness which is fast reducing the terms Democracy and Republicanism to hideous jeer-words of inverted significance?

The roots of institutions and of organizations too frequently spring from the richly manured depths of selfishness. The commercial doctor is despicable enough; do not add the commercial nurse to the terrible burdens under which humanity must stagger!

If the spirit of trades-unionism gets control of your societies and organizations, I hope they will quickly be blown to utter smithereens. The very essence of your life, the heart of your work lies in the personal relation, the wooing back to health and life of bodies and minds hurt in the world’s financial warfare. Send metal, even gold, instead of blood, into your hearts, and you may have very perfect corrosion-images of the cardiac structure for the laboratories of the future nuro-pathologist, but you will then be deservedly dead while the pathologist will be lecturing learnedly upon your fatal disease. I beg that you will keep the financial relations to your patients utterly out of the reach of your laws and by-laws and resolutions. This is absolutely a personal matter to be governed by your character, your ability, your whim and fancy, and by your patients’ condition in life; I hope you will withdraw from any society that in the least attempts to govern you in this matter. Money you must have to live by, as must all of us. Nursing is your trade; it must give you the means necessary for carrying on your trade; but if you wash dishes for money alone they will be dirty dishes when they leave your hands. When your work is an art and when it is with the material called life, the rule holds all the more strenuously; the great God of Life will not allow you to have a master above Him!

This brings us logically to a thought concerning the relation of the nurse to the family of her patient. There is one pretty effective answer to the impertinence of some families which would look upon the nurse solely from the employer’s point of view. If you let such upstarts see that the financial motive is the dominant one in your mind and in your organizations, your answer to the one impertinence is only by another: *I’m as good as you!* But the killing reply to all false pride is the acted one: *I am in truth better than you,*—that is, I will prove to you that I am more unselfish than you. To those who would positively or negatively treat you as a kind of servant paid for by your demanded wage, you may, as does the true physician, teach a nobler way, both by word and action, that while the laborer is indeed worthy of his hire, the hire is not by any means the worth of the laborer.

Not the least of the dangers to which as an organization your guild will be subject is another kind of subserviency—to the physician and to his profession. To steer clear of the Scylla of a too smart independence and the Charybdis of a too decided servanthip will task the tact of the best of you. In all matters pertaining to therapeutics, of course you must be unflinchingly loyal and even obedient to the medical man’s orders. And yet you have your own individuality, and, as an organization, yours should be an entity subject to your own corporate ideals and conditions. There has been much criticism of a tendency, for the existence of which I cannot



vouch, for the nurse to supplant the physician. Many nurses are doubtless wiser than many physicians, but tragedy awaits that nurse who is conscious of the fact, at least if she even whisper it to the person in her mirror!

I suspect the nurse's greater danger lies in the loves and hates of partisanship. "Her favorite doctor" is liked altogether too much, and the one she does not fancy is not half so bad as she thinks. It may be that she needs to rid herself of all such likes and dislikes and fix her attention upon the impersonal aims and needs of her calling. I have heard of chief nurses who turned hospitals topsy turvy and transformed training schools into hotheads of evil and cliques by assigning hated nurses to detested physicians, or by working her girls to death, and other such petty savageries. It is sad,—but possibly the world will be better when you all become head nurses and superintendents!

The business conduct of your organizations will need careful looking after. To be effective, charity itself must become a business. Some wise unwise mot-maker has said that charity is the basest of human passions. Doctors are proverbially bad business men, (though I do not believe they are quite so pitiable as they are represented) but surely despite all their native shrewdness in buying and selling, women will probably commit grievous business errors in conducting their organizations. A lawyer-like prudence is demanded nowadays to guide any great movement right. The friend of whom I spoke tells me that a most excellent scheme of an insurance or beneficial organization for the benefit of nurses went all to smash after great efforts and partial successes because of—but that is another story! Would it be rank heresy to suggest a cool, legal, male brain as an adviser even to the wisest and best of women? Surely the Red Cross Society has lately demonstrated with appallingly glaring colors the need of such a head. When an organization handles millions of dollars without accounting for a cent, it is high time that sane men and women should pinch themselves to see if they are really awake or not. You need to make every training school in America demand a free three-years' educational course with only 8 hours a day devoted to practical work; you need a great journal devoted to your interests and your progress; you need something corresponding to an insurance company adapted to your peculiar conditions; you need a post-graduate school for superintendents; you need a systematization of your business, how to find work, how to supply country towns and farms with trained nurses, where to secure special training, and how to find the people wanting that kind of specially trained nurse, etc.; you need nurses' houses or homes, where you can meet each other, and have something like a town when you are off duty; you need special loan-libraries; you need laws to protect your calling from the scandal of the corrupt, who, for purposes of gain and immorality, don the garb of the nurse; you need a rigid ordering of your relations with the city, the State, and the National Government, and particularly with the military departments; you need an energetic national and even an international organization, and for all these and other things you need wise and clear heads to govern and to guide you, and to mobilize the world's one of the great agencies for alleviating suffering, ill and

bringing about a more lovely civilization than we have so far dreamed of.

And, with it all, will you hate quackery more than you do the devil himself? Already the quacks, those pathogenic microbes of the profession of medicine, those verminous parasites of poverty and ignorance, are quoting Trained Nurse So-and-so as endorsing such and such a concoction or contraption for the magical cure of all disease. I beseech you by all that is holy and of good report, that you renounce this wickedness! When the official head of a representative American nursing organization officially sprawls over and through the advertising pages of the yellow newspaper as a limitless endorser of "Greene's Nervura" and of "Electro-poise," it behooveth you to haul up sharp and see that your skirts do not draggle even in the shallowest of these filthy puddles!

I wish I could say something of use, and that might encourage you to add your influence in providing an effective and systematized service of trained nurses for the United States Army. Whether in peace or in war (except perhaps in the front during actual battle) the army needs you. The lack of such an organization with its resultant terrible morbidity and mortality among the sick soldiers during the late Cuban skirmish was demonstrated beyond all doubt. The Nurses Associated Alumnae of the United States and Canada at their second annual meeting in New York about a month ago, took up this important matter, and are earnestly trying to secure the passage of a bill by Congress to bring about the desired object. In this way only can the business be systematized, the wasted efforts of competing organizations neutralized, and as Carlyle would say, the work get itself done.<sup>3</sup> Another good that would follow the establishing of such systematization would be the disappearing forever and ever, world without end, amen, of the advertising self-seekers, the quack doctors posing as philanthropists, and the silly mob of the charity-becrazed sentimentalists, all buzzing about with their incapacities and fatuities like the myriads of Blue-Bottle Flies of The Four Little Children, described in a wise geographic book actually written before the Hispano-American War!

Women may be divided into three classes, the Good for-somethings, the Good-for-nothings, and the Unspeakeables. There is nothing which fashion hates more than the first class. In its heart it likes the third class far more. With

<sup>3</sup> In our imperialism-craze you must suffer for the sins of your rulers, and must prepare yourselves to meet the demand for nurses in tropical countries where in the name of liberty we are shooting down those who ask for liberty. The English *Civil Nursing Association* was formed in 1896 to provide specially trained nurses for England's colonies in all parts of the world. The *Lancet* makes the wise suggestion to try to train up a school of native nurses. Here is a great work for you also.

<sup>4</sup> "And on the signal being given all the Blue-Bottle Flies began buzzing at once in a suspicious and suspicious manner, the morbid and malicious sounds echoing all over the vastness and resounding across the tumultuous tops of the transitory future, upon the intervening and verdant mountains with a serene and sickly suavity only known to the truly virtuous."

the sharp X-ray eyes of moralized intelligence, look through the walls and roofs of a vast number of modern homes and you will find doleful daughters whom their parents are trying to get rid of, and doleful wives who, money alone excepted, are trying to get rid of their husbands.

When servant-girls marry, the first thing they demand is a servant-girl. Shop-girls—I beg pardon, I mean Salesladies—must not work after marriage, they must ape the vices of the second class of ladies who scorn their too perfect flatterers. Lazy, cunning, pretty, empty-headed, and empty-hearted, the young ladies of the foolish ill-to-do well-to-do, while nursing their hysterics, and their flaccid muscles, manage to twist ever tighter the silken bands whereby, sitting at the center of the commercial economic slaveries of civilization, they draw into their laps the stolen products of human industry and cruelty, avid to get the most and give the least. But even here are awakening, thank Heaven, an increasing number of women who, like Doré's monk, are looking about them with horror and alarm, and are determining that *their* lives at least shall not sink into the degradation of spiderhood. Yours is the splendid proving that there are at least ten thousand American women unsatisfied with araneal ethics.

In other reactions from spiderliness we have many sad morbidities, the "New Woman" being not the very least. Perhaps the "New Nurse" is to be another if she is not wise and wary. Institutional medical charity justifies all the bitterness wrapped in the jibe that "charity is the basest of human passions." If it is incapable of turning all the milk of human kindness to bonnyclabber and even to mitey cheese, if it cannot at one stroke and directly pauperize the patient, curse the giver, and debauch the medical profession, it labors hard to do it by indirection; then if all plans fail, trust some advertising medical college for getting hold of several hundred nurses and making them help the Professors to attain notoriety, students, consultations and iniquitous state appropriations! Organization and Institutionalization may be good things for you, but not unless you are somewhat wiser than serpents and more shy of nets than are many doves.

The most powerful antidote for the evils of malorganization or over-organization, and for the dangers that beset your future career, I believe will be found in the very nature of your calling and in the goodness of the human heart, which rarely fails to respond sympathetically to the cry for help by the suffering.

And this work of yours is so good, and will only remain so good, if you refuse to allow any institution, or rules, or organizations to come between you and your patient. Your calling is of the best and most truly evolutionary (not revolutionary) because it continues the kind of occupation and by the same methods you have inherited from Mother Eve,—personal work by personal methods. The giving of love, care, helpfulness, sympathy, nurturing, nursing,—what else has woman done in the world? What better thing could any being do? The female man-imitators are doomed! Is evolution a word, a philosophy, a thinker's game of thought, or is it the most actual of facts and the most inescapable of biologic laws? There can be no rejection of the law of heredity. The habits of a million ancestors are commands which we seek to break

only at our infinite peril. The fact, of course, is that each of our personalities is the last link of the biologic chain which binds us to the infinite number of our ancestral organisms, and God, if you please, has yet some control of the cosmic process! He will hardly permit the last link to cut itself from the past and set up as an independent existence. The ghosts of all history unite in and direct each individuality. Strength and effectiveness consist in obedience to their orders.

There is one way in which organization can help you, if you, as you must, use it as a tool and not allow it to use you as one. This consists in making it a means whereby you come to your patient. The hospitals have half turned you into servants,—they at least are well supplied with nurses, so we may leave them out of the count. Then the rich have you at command; for we are all the slaves of the plutocrats. Upon them then we may waste no thought or sympathy. The poor, *i. e.* the very poor of the cities, can also command you, through the hospitals. But there are far more needy, more numerous, more worthy classes to whom neither you nor your societies, I fear, have hardly given a thought. Among these are the farmers and the people of small villages. These constitute the great majority of the good people of the United States, and they do indeed need your advice, skill, knowledge, and help, quite as much as do any city-folk. Ignorance and disease await you there fully as much as they do in crowded places. It seems to me that one of your primal duties of organization is to secure a machinery of distribution whereby you and your knowledge of hygiene, the knowledge *par excellence* of the trained nurse, shall be brought to the country and to the village. Genuine missionaries you must be to carry the gospel of nursing to your far-away over-worked and untrained sisters of a million country and village homes, and to the sick ones there.

The reckless poor and the reckless rich of the cities, as we have seen, are well nursed and provided for; they are your masters. But let it no longer be said that "none but a pauper or a millionaire can enjoy the luxury of a nurse." You have yet to organize a machinery to reach the wants of the great and more deserving middle classes. To this class let us add another that still more acutely touches our sympathies,—the proud and self-respecting poor of the cities, who, no worse off financially than the spongers, have as yet not been bribed, corrupted, and herded in the hospitals and almshouses by the professional philanthropists and the selfish charity-mongers. It seems to me that your most pressing duty is to these two sets of people. The clerk, the prudent workman, the little shopkeeper, the working woman, etc., with incomes of from three hundred to one thousand dollars a year—these cannot afford to pay you twenty dollars a week for your services. And if this is so, those with still smaller incomes can afford to pay you but a small percentage of this amount. And for that matter, is your conscientious, skilled, and devoted help for seven days and nights, not really worth far more than twenty dollars? Remember too that your profession is fast filling and like every other, filling to overflowing. Give, then, in advance and in chosen cases, before pitiless competition forces the wage-limit down. But that is a deplorable argument; so let us return to the more gracious, eternally-to-



be-repeated, eternally forgotten, *Noblesse oblige!* Wage-pride in a nurse or a physician is the devil in the pulpit; it is Croker and Quay throned and lording it as statesmen. In this matter I beg and beseech you to think of the duty and the blessing of grace, and the gift of yourselves. Most other giving than self is, in the last analysis, but a fraud and a delusion. Whether you will or will not, you are, if not copartner of the medical profession, at least a chief assistant; and the tradition and the practice of the members of that profession is to give on the average at least one-third of their lives to the needy and suffering, without thought of compensation in money. Verily, verily, I say unto you that you must go and do likewise! If you wish us to love and honor you, that is the surest way to command our honor and love. By what means? Quickly comes the answer: First, by individually meeting the need of the needy with your service, or a part of it, at a price or at no price, corresponding to the ability to pay; Secondly, by means of the Visiting, or District, or Instructive Nursing Society. If there is no such society where you live, then establish such a society! Start it with a membership of one; get others to join; plan it out, work it out, with the help you can and will find if you do really wish to find it. If the established society works badly, if it is the outcome of dilettantism and unbusiness-like sentimentalism, set to work to put it in better order. All things are possible to the resolved woman!

The Instructive District Nursing Associations of Chicago and of Boston, seem to be models. These and similar societies have recognized the profound need of teaching the members of the families among which they go how to become good nurses; how by example and precept to care for each other and for themselves, and in a hundred ways to brighten and purify their lives. A nurse is not a good nurse unless she is a good teacher and inspirer of others to emulate her skill, neatness, and unselfishness. In district nursing one has a greater variety of cases, more out-of-door exercise, greater freedom Saturdays and Sundays, etc. One also, I think, does more good and leaves more lasting impressions. There is a commingling of pathos and fun that is altogether blessed, and seeing more life, one's own character is broadened and sweetened. In the choice and method of carrying on an occupation, the purer the purpose and the more earnest the emotion, the closer must one come to actual life. All desire to get away from the blood and muscle and heart-throbbing of actuality, ends in resultlessness, ennui, and even in downright sin. Keep your finger on the pulse of life if you would know how the heart of life is beating. But all who can, must be made to pay for the work and for the teaching. Selfish charity is very pleasant but it is very iniquitous. Nay, more, all charity is a curse unless it seeks to do away with the need of charity. You must not let your noble calling degrade into vicious relief-doling.

Is aristocratic flummery and class-prejudice beginning to appear among you? I hear whispers of the fact, and in some of the literature I have glanced over, especially in that emanating from England, it crops out in amusing innocence. I have found there such recurring expressions as "Nurses of high birth," "of lower birth," etc. I am treading on dangerous

ground perhaps, but I trust that there is sufficient Americanism in you to scorn such long-eared nonsense. Neither in your speech nor in your hearts let such expressions and distinctions arise. If in the sisterhood of nations our country has any function it is surely to show the unchristianity, the untruth, and the unscience of such prides and such lack-of-prides. The only professional or scientific significance of such terms I can imagine is the obstetric one;—the high-birthers must have entered the world after the manner of Caesar! The common fashion of the low-birthers seems preferable! But I hear that the high-birthers make the best nurses, are better for the instructive and district nursing societies to employ, that they are better received in poor families, that they are not so "stuck up" as regards what is called menial work, etc. Let every low-birther make it her chiefest point of pride to disprove this!

Let me read a few sentences from the history of the Mayflower people by one of them. They surely were low-birthers if there ever were any such:

"But that which was most sadd & lamentable was, that in 2. or 3. moneths time halfe of their company dyed, espesially in Jan: & February, being y<sup>e</sup> depth of winter, and wanting houses & other comforts; being infected with y<sup>e</sup> scurvie & other diseases, which this long vovage & their inacomodate condition had brought upon them; so as they dyed some times 2. or 3. of a day, in y<sup>e</sup> foresaid time; that of 100. & odd persons, scarce 50. remained. And of these in y<sup>e</sup> time of most distres, ther was but 6. or 7. sound persons, who, to their great commendations be it spoken, spared no pains, night nor day, but with abundance of toyle and hazard of their owne health, fetched them woode, made them fires, drest them meat, made their beds, washed their lathsome cloaths, clothed & unclothed them; in a word, did all y<sup>e</sup> homely & necessarie offices for them w<sup>ch</sup> dainty & quessie stomacks cannot endure to hear named; and all this willingly & cherfully, without any grudging in y<sup>e</sup> least, shewing herein their true love unto their friends & bretheren. A rare example & worthy to be remembered. Tow of these 7. were Mr William Brewster, their reverend Elder, & Myles Standish, ther Captain & military comander, unto whom my selfe, & many others, were much beholden in our low & sicke condition. And yet the Lord so upheld these persons, as in this generall calamity they were not at all infected either with sicknes, or lamnes. And what I have said of these, I may say of many others who dyed in this generall vissitation, & others yet living, that whilst they had health, yea, or any strength continuing, they were not wanting to any that had need of them. And I doute not but their recompence is with y<sup>e</sup> Lord."—*The Bradford History of the Plymouth Plantation.*

"Servants of the poor" is another term used by orators to graduating nurses and by writers of mock heroics. It is quite highfalutin—and quite silly! I trust you will not go to your life-work a victim of any phrase-maker's tricks. Your first duty, like that of all of us, is to see facts; your second, is to know facts; your third, is to make facts. If you must dub yourself with any other titles and think of yourself as anything less or more than a nurse—quite a noble and ennobling name, I think—is not the word *friend* enough? A servant you must not be, a patronized or a patronizer you dare not be. Friendship is what is needed by the patient and by his family. The friend may teach and help, not serve or patronize; he must always sympathize with and love.

You may gather that I have a more vivid feeling of the



dangers than I have of the benefits of organization, and I shall not very emphatically deny the charge. The shame and infamy of anti-Dreyfus France, the degradation of American boss-politics, the cruelty and selfishness of monopolies, our pension demagogery, such things are ever before our eyes to warn us against giving up our freedom and our honor to any organization. The hardest of all problems you will have to solve will be to secure the good things that are obtainable only through organization and at the same time to avoid the evils so generally the consequences of organization.

It is only by means of money that one can get that which is worth more than money, and that which money cannot buy. Just so it is only by means of organization that you can obtain that which organization alone cannot give. This means, of course, that you must use the power derived from organization as a mere instrument. There is nothing more harmless, neutral and unorganized than water—the oceans of it that cover so much of the earth. There is nothing more symmetric and beautiful than a snow crystal; but transmute an ocean into a polar ice-cap, and death is its command, even to the wandering splinter of it called an iceberg. Let love and ethics fail for a day to use, fill and thrill your organizations, and the devil will surely seize upon them and make them serve his purposes.

In the polar regions of our earth the cold is so intense and continuous that ice and snow are always forming and it is

impossible to say what would be the disastrous consequences as regards the temperature, climate and vegetation, even the life of the entire globe, were it not for the existence of one great countervailing fact: Up from the great oceans of the equatorial and temperate regions softly creep the massive currents of warmer water, until approaching the poles, they dip deeply downward beneath the arctic ice-cap, and spreading through these freezing ocean abysses, they bring the melting messages from the far-away sun, from summer days and smiling climes. Your work in life seems wonderfully like all this. However lethal and frightful our civilization, it shines with such splendid and alluring auroras that into it with reckless fatalism press the infatuated discoverers and travelers from lands where labor wearies and deadens, and where love is becoming the legend of idle singers of empty days. Over this white waste of frigid expanse deepen the glaciers of selfishness, and glitter the ice and snow of luxury and of greed. Among the influences that prevent this palsyng congelation of death from crawling and crunching through the whole wide world, comes Love! And what love is purer and more vivifying than that of you workers, what more heartening than that which gives itself to win back to health, to hope, and to life, those who have been broken by disease and worn by suffering? Yours the privilege, cosmic and yet personal, of throbbing beneath and through the bitter chill of an icing civilization the softening warmth of divine beneficence and love!

## A PIN IN THE VERMIFORM APPENDIX.

BY JAMES F. MITCHELL, M. D., *Assistant Resident Surgeon, The Johns Hopkins Hospital.*

In the Johns Hopkins Hospital BULLETIN, Nos. 94, 95, 96, January, February, March, 1899, was published a collection of thirty-five cases in which pins had been found present in the vermiform appendix, or had been the cause of attacks of appendicitis.

Since this publication a most striking case has appeared in the service of Dr. Halsted, and in connection with the subject seems worthy of record.

*History.*—W. O. R. (Surge. No. 8898), a colored boy, aged seven years, was admitted to the surgical wards April 26, 1899, complaining of "cramps in the stomach."

Since he was two years of age he has suffered from repeated attacks, with abdominal symptoms referable to the right iliac region and accompanied by pain, tenderness and vomiting. These have recurred at intervals of a few months for the past five years, the duration of the attacks varying from a few days to one or two weeks. The intervals have never been completely free from local symptoms.

No history of the ingestion of a foreign body could be obtained from the parents.

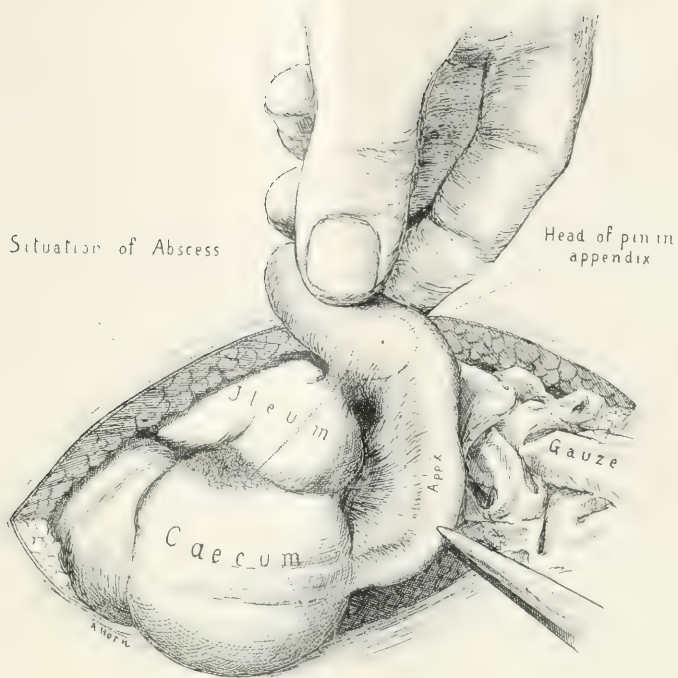
On April 22 (four days before admission) he complained of feeling badly, and of a feeling of tightness in the abdomen followed in a short time as usual by cramps and vomiting; no chill; not much apparent fever. Since onset there have

been paroxysms of pain about the navel, the attacks lasting three or four minutes and being so severe as to cause him "to be doubled up." Abdominal tenderness has been marked; bowels constipated, one movement yesterday, after medicine; no pain on micturition, but increased frequency.

*Examination on admission* (Dr. Cushing). "Well developed colored child with slightly pinched facies; lying on back with knees drawn up. Pulse compressible, rather poor quality. Tongue has a diffuse, thin, white coating. Respiration costal in type; abdominal movements slight. *Abdomen* slightly and symmetrically distended. Child protects right iliac region with hands. Dulness over whole of right iliac region. No dulness in left flank. Abdominal spasm and rigidity limited to right iliac fossa render palpation difficult. There seems, however, to be a mass in the right iliac fossa. Temperature 103.2°. Leucocytes 11,000." He was prepared for immediate operation.

*Operation under chloroform anaesthesia* (Dr. Cushing). *Laparotomy for appendicular abscess. Evacuation of abscess. Appendectomy. Pathological anastomosis of tip of appendix with ileum, through which a pin passed, producing a perforation in opposite wall of ileum. Closure of two appendicular communications. Drainage.*

Under anaesthesia the tumor was found to occupy the



### Pin perforating Ileum

From a sketch at the time of operation by Dr. Cushing. Showing the relations of the pin to the appendix, ileum and caecum.



The appendix and ileum showing the pin encrusted with fecal matter.





whole right iliac region from median line to level of umbilicus. Incision was made over the tumor through outer layer of rectus muscle, and subsequently enlarged, dividing the epigastric vessels. The abdominal wall was oedematous. The tumor mass was covered by a layer of infiltrated omentum, which was adherent to anterior parietes. Adhesions were freed and walling-off gauze placed about the mass at point of approach to the free cavity.

The tumor mass was attacked and an abscess containing about 15 cc. of bad smelling flocculent pus evacuated. Cover-slips showed some bacilli, no streptococci.

The appendix was sought for and finally freed from the side of the tumor mass. No perforation could be made out in the appendix. The abscess was situated at some distance from it, lying between cæcum and ileum. The appendicular serosa was not markedly injected. The appendix was found to have a double communication with the bowel: one at its base and another about 2 cm. from its tip, where it anastomosed with the ileum by a free communication opposite to the mesentery.

In the appendix opposite to this communication a hard, round body, the size of a hat-pin head, could be felt, and running from this through the passage into the ileum extended the shaft of a pin, the point of which reached the abscess some distance away.

The meso-appendix was tied off and the appendix amputated at its base, the stump being inverted into the cæcum. The communication with the ileum near the tip was treated in the same way, the opening into the ileum, which was lined by mucous membrane, being closed by three mattress, Halsted sutures which had been placed before the division.

The seat of operation was drained with iodoform gauze and the abdominal wound partly closed.

The patient took the anaesthetic well and had no bad symptoms referable to it.

The operation was performed in the afternoon and the child seemed in good condition at its close, although the pulse was rapid—134. During the evening he was comfortable and apparently doing well. Frequent salt-solution enemata were given to relieve thirst. At midnight he was seen by Dr. Baer, the ward surgeon. The pulse was then 116 and of fair volume and the patient complained only of slight pain.

At six o'clock next morning the nurse noted no change in his condition; pulse slower. Happening to pass his bed a few minutes later she noticed his eyes rolled up and glassy, and was unable to rouse him. Attempts to resuscitate him were unavailing and he died at 6.45 a. m.

*Autopsy* (Dr. MacCallum) showed localized peritonitis, about cæcum; broncho-pneumonia of slight extent; great enlargement of thymus; small hemorrhages about thymus and mediastinal tissues; moderate glandular hyperplasia.

No definite assignable cause of death.

*Bacteriology*.—*Bacillus coli communis* and an unidentified bacillus were obtained from the appendix. (Dr. Clopton) cultures from the heart, spleen and thymus gland were sterile. *Pneumococcus* was gotten from the lungs, and from the kidney and liver *Bacillus coli communis*. Cultures from the kidney, liver and peritoneal cavity gave an unidentified bacillus, probably *proteus Zenkeri*.

## THE PRESENCE OF TYPHOID BACILLI IN THE URINES OF TYPHOID FEVER PATIENTS.

BY NORMAN B. GWYN, M. B., *Assistant Resident Physician Johns Hopkins Hospital.*

It has been frequently shown that typhoid bacilli may be present in the urine of typhoid fever patients and convalescents and that the danger of infection from this source was seriously to be considered; up to the present time, however, we have completely overlooked this question, and systematic disinfection of the urine has never been perfectly, if at all, carried out. If the presence of these bacteria in the urine were but an occasional happening and associated always, as in some cases, with urinary disturbances marked enough to attract attention, and arouse suspicion, no great danger of infection need be feared, but their occurrence in 20 to 30 per cent. of all cases, often in urines presenting slight if any alteration, makes it very evident that in the spread of typhoid fever the urine plays a far greater part than has heretofore been suspected. Bouchard, in 1881, seems to have been the first to describe this condition, his investigations showing bacilli in 50 per cent. of cases; faulty differentiation of the typhoid from colon bacilli may have given this high percentage.

Hueppe, Seitz, Konjajeff, Karlinski, Neumann, Borges, de la Faille give varying results in describing the same condition. Hueppe finding bacilli but once in eighteen cases,

Karlinski in twenty-one of forty-four. Blumer, in this hospital, investigating pyuria in typhoid fever found typhoid bacilli twice in sixty cases. Wright, of Netley, obtained typhoid bacilli in the urines of six of seven cases. Besson in six of thirty-two. Neumann noted that the bacilli were usually in pure culture and were often so abundant as to render fresh urine turbid, the urine remaining, however, acid in reaction; the evident danger of infection is emphasized by this writer and others.

More recent work has been done by Petruschky, Horton-Smith, and Richardson. Petruschky, though obtaining bacilli but three times in fifty cases, dwells upon the number and persistence of the organisms, calculating that in one case 170 million of bacilli were present in one cubic centimetre of the urine; persistence of the bacilli for three months after convalescence was seen in one case.

Smith found bacilli in three of seven cases and confirming Neumann's observations, adds that it is often possible to detect the organisms in the freshly-voided urine.

Richardson's investigations are perhaps the most important. In two series of thirty-eight and sixty-six cases of typhoid

fever, bacilli were obtained from the urine in nine and fourteen instances; the time of appearance, the persistence and disappearance of the bacilli, the coincident condition of the urine, and therapeutical resources for removing the organisms are fully discussed.

The results obtained by the above observers may be thus briefly tabulated:

1. In quite a high percentage, perhaps from twenty to thirty per cent. of all cases of typhoid fever, typhoid bacilli may be present in the urine.

2. When present they are usually in pure culture, often so numerous as to make the freshly-voided urine turbid and may then be detected by a coverslip examination.

3. Appearing generally in the second and third week of illness, the organisms may persist for months or years, probably multiplying in the bladder, the urine being apparently a suitable medium for their growth.

4. Though often showing evidences of cystitis, and marked renal involvement, the urine containing bacilli has usually only the characteristics of an ordinary febrile urine; the presence of bacilli has no prognostic importance, and their disappearance or persistence without having induced local change is the rule.

5. Lastly, as shown by Richardson, irrigation of the bladder with bichloride of mercury, and the internal administration of urotropin, a compound of ammonia and formaldehyde, seem to be safe methods of removing the bacilli; thirty or sixty grains of the latter quickly removing all bacilli in six cases.

In discussing the conditions under which bacilli may be present in the urine, it must be mentioned that an association of bacteriuria with the typhoid roseola was early noted and has been mentioned by most observers. Konjajeff held that bacteriuria indicated always the presence of the lymphoid nodules in the kidneys; according to Borges some impairment of the renal tissue was always necessary to allow passage of bacteria; Wright sees in the bacteriuria and roseola clear evidence that typhoid fever is a general infection; Blumer thought that occasionally the bacilli came to the bladder through the anterior rectal wall; Futterer's work showing the almost immediate appearance in the gall-bladder and urine of organisms injected into the portal and jugular veins, together with the fact that many urines containing bacilli show no evidences of renal changes, may be taken as indicating that the typhoid bacilli may appear in urine as a simple excretion from the blood. That typhoid bacilli are present in the blood in practically the same per cent. as in the urine is seen from the work of Kühnau and others.

Since Blumer's investigations in 1895, no bacteriological examinations of typhoid urines have been followed in this hospital. The occurrence of several cases of cystitis in the typhoid cases, and the outbreak of a small house epidemic of typhoid fever drew our attention thereto; although in the first case examined aspiration of the bladder was resorted to, it was found that cleansing the meatus and anterior urethra with 1-50000 bichloride sufficed to give pure cultures in almost every case, the standard tests for differentiating the typhoid bacillus were employed; if on examination of the fresh speci-

men no organisms were to be seen, as much as five to ten cubic centimetres of urine were plated out.

In most of our cases pyuria and signs of bladder irritation were present, the development of which led to the bacteriological examination; in others the urinary condition aroused no suspicion.

Case I, for the report of which I am indebted to Dr. Cushing, was at once the most remarkable and interesting, presenting a chronic cystitis of four years' duration, following shortly after an attack of typhoid fever. Pure cultures of typhoid bacilli were obtained on aspiration of the bladder; the patient left the hospital much relieved by bichloride irrigations. Unfortunately we have not been able to follow the further history of this case. Houston reports a somewhat similar case of three years' duration.

Case II showed the development of an acute cystitis at the end of a relapse six weeks from the onset of his illness; typhoid bacilli in large numbers were obtained in pure culture from the urine; the pyuria and symptoms cleared up on irrigation (bichloride of mercury 1-50000) and at present, three months after discharge, urine is quite clear and, on culture, negative.

In Case III, an outside case; marked pyuria in the third week together with the fact that the patient had never given a Widal reaction induced the physician to have cultures taken from the urine; the examination of the fresh urine showed myriads of motile bacilli, proving on culture to be typhoid; the urinary condition improved on bichloride irrigation, and three months later the urine was clear and showed no bacilli on culture.

Case IV developed pyuria in the fifth week of his illness. Numerous bacilli were present in the fresh urine; the urinary condition cleared up on bichloride irrigation; patient could not be followed after his discharge.

In Case V, the development of a cystitis three months after an attack of typhoid fever; typhoid bacilli were present in abundance in the fresh urine; the condition improved on irrigation and an examination three months later showed the urine clear and no bacilli.

The three next cases we could follow more closely, and could also watch the effect of urotropin on the bacteriuria.

In the first of these a severe nephritis and cystitis had developed in the third week of illness; the freshly-drawn urine was turbid from presence of pus and innumerable bacilli; it could be calculated in this case that 500 million typhoid bacilli were excreted in each cubic centimetre of urine.

Urotropin grs. x three times daily was begun and in two days no bacteria were to be seen in the urine, ten colonies of typhoid bacilli however growing on culture from one cubic centimetre; the nephritis and cystitis improved and after 5 days no bacilli could be cultivated; cultures remained negative for two weeks and the urine was now free from all traces of nephritis or cystitis. At this time however although patient was still taking urotropin, and after six hundred and thirty grains had been administered, typhoid bacilli reappeared in considerable numbers.

In the second of these three cases pyuria and signs of cystitis developed in the third week of illness, numerous bacilli were to be seen in the turbid fresh urine, which bacilli, though the

patient had never given a Widal reaction, proved to be typhoid organisms; after 80 grs. of urotropin grs. v three times daily the bacilli disappeared and pyuria improved, but in spite of the fact that urotropin was continued, both bacilli and pus reappeared on the eleventh day of treatment, or after 165 grs. of urotropin had been given. Treatment was continued, and in six days more bacilli disappeared entirely, and have never reappeared. In this patient it was calculated that 3 million typhoid bacilli per cub. centimetre were being excreted at the time of first examination.

The last of our cases, one of typhoid septicaemia, running an irregular course with intermittent fever and chills, and one in which the Widal reaction was at first uncertain, had nothing in the urine to attract attention, there being but a trace of albumin and slight turbidity. The turbidity was found to be due to innumerable typhoid organisms. Urotropin grs. x three times daily reduced the number of organisms to one hundred per cub. centimetre in four days. The patient died on following day still showing few bacilli in the bladder. Typhoid bacilli were found everywhere throughout the body at autopsy and in the blood before death; till the appearance of a marked Widal reaction the urinary condition in this case gave the only reliable indication of the nature of the illness, and it seems reasonable to suggest that in cases where the Widal reaction is delayed a bacteriological examination of the urine should be made, especially since it has been repeatedly shown that with the presence of the typhoid bacillus in the blood, the serum reaction may be long delayed or feeble. This absence of the Widal reaction with presence of bacilli in the urine was noted in two of the foregoing cases. As most of our cases were selected for examination on account of their urinary condition we cannot use them to figure percentages of results. In a later series of seven cases positive results were obtained in the three final cases above recorded, or in 42 per cent. of cases.

We were not able to determine at what time the bacilli appeared in the urine, their persistence for four years in one case and three months in another being seen. In the latter case the urine showed nothing suspicious till the development of cystitis at the end of three months; this patient during convalescence probably excreted millions of bacilli daily, and might have continued so to do had his urine not come under observation; estimating, as in one of our cases, 500 million bacilli per cubic centimetre of urine, a daily amount of 1000 cc. of urine would contain 500,000 million organisms. According to Petruschky's calculation, such a urine if diffused in ten cubic metres of water or sewage would give 50,000 colonies of bacilli per cubic centimetre of the water. In most of our cases there was pyuria; albumin was present twice in large amount, usually however, only in traces, with albumin generally a few hyaline and granular casts; in one case the urine showed no pus and neither albumin nor casts; complete repair of the affected bladder or kidneys, as far as could be seen from the urine, was the rule, the cystitis of four years' duration had been untreated and had become very chronic.

The observation of Neumann that in typhoid fever cloudy, freshly-drawn urine acid in reaction could usually be sus-

pected, was frequently confirmed, the possibility of detecting the bacilli in the fresh specimen as emphasized by Smith, being shown in all but one case. For the removal of the bacilli, bichloride irrigations (1-50000) were completely effective in three of five cases which could be followed; 165 grains of urotropin removed the bacilli in one case; in another reappearance of the bacilli during its administration was seen; in a third there was immediate reduction of the number of organisms, the death of the patient preventing further observation.

The infected urine could be readily rendered sterile in half an hour by the addition of an equal volume of 1-10 carbolic acid.

Since typhoid bacilli are present so frequently and in such abundance in the urine, unless a systematic bacteriological examination can be made, all typhoid urines should be disinfected before being thrown out; great care should also be exercised in the handling and routine examination; careful centrifugalization of urine is usually possible and in the absence of cultural tests should be insisted upon; detection by this means of bacilli in fresh urines, should suggest the applicable anti-bacterial treatment and proper disinfection of the urine.

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#### DISCUSSION.

DR. HARRIS.—We are greatly indebted to Dr. Gwyn for this painstaking work in regard to the very important question of the elimination of typhoid bacilli through the urine. It is remarkable that as long as the organism has been known to be so very ubiquitous more examinations have not been made heretofore of the urine. The necessity for examinations of the urine as a matter of routine in all cases should be strongly brought forward. I would like to ask Dr. Gwyn some questions regarding his methods of procedure. Were dilutions made, or were plates made straight from the urine; and secondly, was any attempt made to exclude the so-called pseudo-organisms? In some of our analyses we have met with an organism that gave the reaction of the typhoid bacillus in all culture media, except in gelatine which it slowly liquefied, and even there it would be from ten to fourteen days before



it would show this difference from the typhoid bacillus. With the dry blood method it always gave a pseudo-reaction, that is, an imperfect clumping, which in a hasty examination might be mistaken for the action of the typhoid bacillus. I would also like to ask if he has tested the Hiss media, which is said to far surpass Elsner's in respect to efficiency.

As regards the lurking of the organism in the bladder for so many years is it not possible that the patient may be re-infected and a nephritis or cystitis set up by the second invasion without any of the usual symptoms of typhoid? Hearing upon my question there was a case I believe in the hospital last summer in Dr. Young's service where he credited the patient with carrying the organism for seven years. He isolated the organism and permitted me to go over the work and it was evident that he had obtained the bacillus typhosus; but he had great doubts as to whether the patient did really suffer with cystitis all the years after the primary infection.

As regards the finding of the organism in the urine I would like to know whether it has been isolated at any time in the absence of albuminuria, cystitis, or symptoms of nephritis. There are cases on record in which the urine has been reported as completely free from evidences of bladder or renal involvement; practically always, however, slight traces of albumin are found with few casts. These are matters I

think that would make the routine examination of the urine very necessary. The disease may be spread, especially in country families, through the friends attending the patients and then going about ordinary household duties, neglecting the disinfection of urine and faeces of the patients, and of their own hands.

DR. GWYN.—I would say that in many of these cases a dilution was not necessary. As to the tests for differentiating the typhoid bacillus the usual tests, the growth in ordinary media, the motility of the organism, the non-production of indol and especially the serum test, were always used. We have not used Hiss's media this year, but I have used it before with satisfaction. In many cases the urine will show quite large amounts of albumin with casts and pus; evidences of acute nephritis and cystitis. In the majority of cases a mere trace of albumin with few casts and little or no pus will be found. Cases are reported in which the urine has shown absolutely no evidence of changes, either in the kidneys or bladder. All of our cases have shown at least a trace of albumin.

The first case I referred to is, I think, that which was under Dr. Young's care.

## A CASE OF GENERAL INFECTION BY THE DIPLOCOCCUS INTRACELLULARIS OF WEICHELBAUM.

By N. B. GWYN, M. B., *Assistant Resident Physician, Johns Hopkins Hospital, Baltimore.*

The *Diplococcus intracellularis meningitidis*, now recognized as the causative agent of cerebrospinal fever, while found in the meningeal lesions, has not as yet been demonstrated in the general circulation, nor have we known it to play the part of a general infective agent. During the past few months there have been admitted to Professor Osler's wards a series of 11 cases of cerebrospinal fever, and in one of these the specific organism has been demonstrated not only in the meningeal lesions, but in the blood and in the inflamed joints. The history of the case is as follows:

Jacob B., aged 24, native of the city, was admitted November 4, 1898, supposed to be suffering from typhoid fever. The patient was a packing-clerk in a manufactory, and had always been strong and well. There was no history of contact with any cases of meningitis. On Nov. 1, after two or three days of slight indisposition, the patient was seized with severe pain in the back of the neck; subsequently he had a chill with nausea, vomiting, and fever. On Nov. 2 he was very much worse. He had become delirious and was feverish. He had diarrhoea, and friends noticed that there were "drawing" movements of the hands. There was no retraction of the neck nor any stiffness of the muscles. On Nov. 4 he was seen at home by Dr. Hastings. The temperature was 100.8°; he was delirious; the limbs were very rigid; the spleen was palpable, large, and firm. He was ordered to be sent at once to the hospital. The condition on admission was as follows:

He was a well-nourished man; the cheeks were flushed, the pupils dilated, equal, reacting to light and on accommodation. He was unconscious and could not be roused. The tongue was coated;

the throat was clear. The rigidity of the muscles of the neck and back was marked, and the body could be lifted with the hand placed under the occiput. The respirations were quick and jerky and there was impaired resonance in the right axilla. The pulse was 140, temperature 100.2°, respirations 44. There were swelling and redness of both elbows, the right wrist, the right knee, and several of the smaller joints of the hands.

On Nov. 5 he remained in much the same condition, with marked rigidity of the neck and of the abdomen. Purpuric spots developed about the feet. The defective resonance over the right lower lobe of the lung increased, and was present also in the left infrascapular region. The affected joints were more swollen and red. Slight external strabismus had developed. A reddish purple mottling of the skin of the body and extremities was noted. The urine contained a large amount of albumin with hyaline and granular casts and red blood corpuscles. The patient gradually failed and died at 10.40 on the morning of the 6th, the temperature having gradually risen to 105.5° before death. The leucocytes increased from 17,000 per cubic mil. on admission, to 37,000.

Lumbar puncture was performed on November 5, and cultures were taken from the blood and from the swollen and inflamed right knee joint. By the lumbar puncture a rather characteristic seropurulent exudate was obtained. In it the characteristic hemispherical diplococcus was found, both in the leucocytes and lying free, isolated, and in small clumps. Numerous large swollen forms were also seen, all of these readily decolorized by Gram's stain. Cultures from the meningeal exudate were made by inoculating the surfaces of Loeffler's blood-serum and glycerin-agar tubes with a large quantity, as much as one-half cc. After 18 hours in the thermostat at 37°C., the blood-serum and glycerin-agar tubes

showed a characteristic growth—small, isolated colonies from  $\frac{1}{4}$  to  $\frac{1}{2}$  mm. in diameter, on the Loeffler's blood-serum, raised, soft, viscid and white, on the glycerin-agar, rather translucent, the colonies, as seen by the microscope, being finely granular with regular borders. Morphologically the organisms showed typical biscuit-shaped or hemispherically-shaped cocci, arranged as diplococci, staining well with gentian violet, better with methylene blue, and decolorizing readily by the Gram stain.

From the knee joint about 3 cc. of thick, yellow stringy pus was obtained. Hemispherical diplococci, both intracellular and extracellular, were found in it, corresponding in morphology to those found in the meningeal exudate. Of the plates taken from the knee-fluid the blood-serum agar showed numerous small colonies about  $\frac{1}{4}$  mm. in diameter, the agar plates showing also nine or ten smaller ones. The organisms were identical in form and staining reaction with those from the meningeal exudate.

*The Blood.* 10 cc. were taken. On the blood-serum agar plates three minute but well-marked colonies grew. They presented the typical hemispherical cocci easily decolorized by Gram's stain. In a tube of undiluted blood at the upper end of the clot which had formed, there was a faint, greyish patch, in which were diplococci similarly arranged and of similar staining reaction. In all of the cultures there were found occasional, deeply-staining, large, swollen diplococci, and others again which remained pale among the neighboring well-stained organisms.

Further cultures from the knee and blood gave typical growths on Loeffler's serum. The cultural peculiarities of the organisms from the three sources were identical and are as follows: on agar, faint growth of isolated, small colonies; in litmus-milk, no change noted, no coagulation, no acidification; growth was proved by reinoculation from the litmus-milk tubes. In bouillon, a slight cloudiness with a stringy precipitate. On potato (slightly acid) there was no visible growth, though the organisms could be demonstrated

on coverslip. In gelatin and glucose-agar there was a very slight, disconnected growth, with no evolution of gas in the latter, nor liquefaction of the former.

Transplants from the undiluted blood tube gave no further growth.

In all the protocols the characteristic diplococcus, decolorizing by Gram, could be demonstrated. The feebleness of the growth of the organism was shown by the number of inoculated tubes which remained sterile, and in the fact that after 48 hours on a culture-medium reinoculation frequently gave negative results. The morphological and cultural qualities show that the organism from the three sources was identical, and was the diplococcus intracellularis meningitidis or meningococcus.

This is believed to be the first instance recorded in which general infection or septicæmia has been demonstrated in this disease. In the report on epidemic cerebrospinal meningitis Councilman, Wright, and Mallory make the statement that "so far as can be learned from cultures of blood, liver, spleen, and kidneys, at the post-mortem, septicæmia is never produced. The organisms may have been present and not grown out on cultures. They are never found except in connection with the lesions of the disease."

The autopsy on this case showed the organisms only in the characteristic lesions in the brain and cord. No serum-reaction could be demonstrated. Of special interest is the fact of the separation of the organism from the inflamed joints, which throws light upon the cause of the arthritis, not infrequently associated with the acute infections, and particularly with cerebrospinal fever.

## CORRESPONDENCE.

### A PIN IN THE APPENDIX VERMIFORMIS.

MAY, 1, 1899.

*Editor of the JOHNS HOPKINS BULLETIN, Baltimore.*

*Dear Sir.*—In your issue of January, February and March, there is an article by Dr. Mitchell on foreign bodies in the vermiform appendix with special reference to pointed bodies. I was not aware that these cases were so rare.

I reported such a case to the New York State Medical Journal, Oct. 24, 1896. In this instance the appendix had ulcerated and perforated; nature had taken care of the condi-

tion with adhesions. After the appendix was removed we found a pin in the appendix, head down, with the point caught in the wall. Upon inquiry later the little fellow said he had swallowed a pin about a year previous while playing with his brother, who tried to take it away from him, and he swallowed it to avoid his brother getting it.

Yours very truly,

D. C. MORIARTY.

511 Broadway, Saratoga Springs, N. Y.

## PROCEEDINGS OF SOCIETIES.

### THE JOHNS HOPKINS HOSPITAL MEDICAL SOCIETY.

*Monday, February 6, 1899.*

**A Demonstration of Intestinal Anastomosis by Means of a New Forceps.**—Dr. ERNEST LAPLACE.

*Mr. President, Ladies and Gentlemen.*—Allow me, if you please, the privilege of expressing my great appreciation of the honor conferred upon me in being allowed to appear before the Medical Society of the Johns Hopkins University. It is a compliment, perhaps the greatest one that a member of our

profession can have at present, because of the credit which the Johns Hopkins University has brought to the profession of medicine in America. This is only appreciated by those who have traveled over this country and abroad and learned of the standing of your members. Therefore when I realize that I am with you to-night I find it impossible to express my true feelings and I can only hope that you will think me sincerely thankful for the privilege of being here.

The object of this demonstration is to show an instrument that has for its purpose the facilitating of the operation of

anastomosis. Without entering into a consideration of the operations done heretofore for this purpose, all of which have their advantages and, of course, some disadvantages, I believe it is agreed among surgeons that the ideal operation is that performed by means of sutures, that operation by which the ends of the gut are sutured together, and it matters little whether we use a continuous, a Lambert or other suture. The suture operation is the operation of to-day, and I believe is destined to be the operation of the future. Any apparatus, any instrument, any contrivance that can facilitate the accomplishment of this operation is, I believe, something to be studied and if it possesses any merit, something to be adopted in such cases as require rapidity. We know that rapidity in operating will diminish the amount of shock, and may, perhaps, remove the last straw that would have broken the camel's back.

Now I have been trying for some time to devise these simple forceps which consist only of two ordinary hemostatic forceps, bent or curved at the end into a semicircle so that placing the two together they form a complete ring or circle. Then I have a little clasp here which holds them together. Now these two rings are to subserve the same purpose that the Murphy button or the Halsted rubber bags do, or that any other support within the gut can accomplish and in addition, no matter what stitch you use, these rings can be removed just before the last stitch is placed, without any difficulty.

I shall now demonstrate the manner of operating on the intestines which we have here. Inasmuch as we have to deal with intestines of different caliber we have devised five different sizes of the forceps as seen here. The smallest is for work on the gall-bladder, and it makes a quick way of operating.

I have here a stomach and a bit of intestine and my purpose shall be to unite the gut to the stomach. Putting them side by side in this way, I take the knife, and, depending upon the size of forceps I wish to use, I make the incision. Here I shall make a large one and use the large caliber forceps. Making the incision directly into the stomach and then one into the gut I have here the two openings, into one of which I introduce one blade of the forceps, and into the other the second blade and they are ready to clasp. Now when this is done the operation is practically over. All I have to do is to put the stitches in.

Now as I go around the gut towards the end of the area to be sutured I reach that part of the operation which is ordinarily difficult to perform. Here, however, my assistant will simply turn the forceps over, reverse the whole thing for me and, as he brings the unsutured portion of the gut before me, what has heretofore been so difficult, is now the easiest part of the operation. Now I have sutured it all around, except where the handle of the instrument projects through the wound and I want to remove it. I first remove the clasp, which allows the two halves of the forceps to fall apart and then, drawing out one half, not straight, but describing a semicircle, it is easily removed and the other half can be made to follow in the same way. Now all I have to do, is to put in one more stitch and the operation is finished. I shall now make an opening in the stomach, however, and show you that the gut is perfectly patulous.

Now let us do an end to end anastomosis. Wishing to unite the two ends of the gut you first measure for the size of the forceps needed and to make sure that the mesenteric surfaces will meet, you begin by placing the four fixation sutures at the four cardinal points. Now I can introduce the forceps anywhere between these stitches. Dr. Cushing very properly asked me to-day, "What would you do if you had to anastomose guts of different caliber?" The answer to that is that I should invaginate the two ends, and for that purpose I have devised this little instrument for catching the gut at its border, dipping it down into the bowel, stitching it nearly all the way around, and then withdrawing the forceps.

Now gentlemen, this I believe meets all the possible indications for operation upon the intestines. I first presented this method at the last meeting of the American Medical Association in Denver, last June, and on the same day it was published in the Philadelphia Medical Journal. I have since then demonstrated it in Philadelphia and other places. At one of these demonstrations I invited a gentleman in Philadelphia to see the operation, and at its close he told me that he could simplify these forceps, and within 24 hours he exhibited the forceps he had made. His description of them was published last Saturday in the Philadelphia Medical Journal. I wish therefore, in justice to this instrument, to say a few words, not in criticism of his forceps, but simply to show how they were developed. It is natural to suppose that in getting up an instrument of this kind it did not jump into existence all of a sudden; it had to grow, as it were. The idea was to have a ring that would be removable and it was natural to think first of a ring such as he devised instead of one like this, and in fact, the very first forceps I made had exactly the shape of that published by this gentleman last week; it was  $\frac{2}{3}$  round and  $\frac{1}{3}$  open. He has no claim to originality except that the forceps are simpler than mine. You can easily see that when I remove one-half of these forceps at a time I have to describe a semicircle, and if either branch of the forceps were more than a semicircle I should have to make the turn something more than a semicircle to remove it. In other words, to divide a ring into the two smallest possible portions I must divide it in half, for if one portion be smaller than a half, the other must be larger. This gentleman published his claim 24 hours after he first thought of the idea and he therefore had no opportunity to test it, and he does not know what I learned by experience. I claim therefore that while his may be simpler it does not meet all the requirements of the case and I have given mine the shape you see because it seems to be the simplest possible instrument that will meet every possible emergency. I have in my possession the first forceps I used for this purpose more than a year and a half ago, which are like those published Saturday, and which I discarded because it was not the required thing.

DR. HALSTED.—I should think that for a lateral anastomosis it promises all that Dr. Laplace claims for it and we shall certainly give it a trial very soon. It is quicker, much quicker, I should say, than the method we employ; I cannot say how many minutes, because, of course, one cannot deter-



mine that point by work upon alcoholic specimens. I should think it would be of great assistance especially for cholecysto-enterostomies. It is possible, of course, to do this operation without an instrument, but it is a very difficult one.

I was interested in Dr. Laplace's reply to Dr. Cushing's question as to what he would do in an end-to-end anastomosis if the guts were of different sizes. If I understood him he would really do a lateral anastomosis, or reduce them to the same caliber. The fact is that in surgery one very often, perhaps usually, when doing end-to-end anastomoses, has to deal with intestines of different sizes. I think we have had three or four within the last year where the intestines were of different size and it is a question still, I suppose, as to whether it is not advisable, if possible,—if it is not preferable I mean, to do an end-to-end anastomosis rather than a lateral anastomosis, because we do not, as you know, have as good ultimate results in the latter as in the former.

DR. LAPLACE.—I believe that in such a case as Dr. Halsted speaks of, if the gut is distended and thin it can be puckered up in the manner I have hinted at, that is, having made the four cardinal sutures, if the guts do not invert, all you have to do is to insert a temporary suture, pucker the large gut and then continue as you would with the Murphy button.

#### A New Operation for Vesico-vaginal Fistula.—DR. KELLY.

I wish to present two interesting cases which I have had during the past year, in which I have been obliged to resort to new procedures in operating upon vesico-vaginal fistulae. You all know very well that the history of the vesico-vaginal fistulae instituted an important era in the history of surgery at large; in fact, I imagine the enthusiasm over the work of Robert of France, Sims of this country, and Simon of Germany, was due to the fact that men recognized that it was the replacing of older surgery by newer and more accurate work. Now when Sims closed vesico-vaginal fistulae and succeeded as no one had succeeded before, and as Dr. Emmett succeeded even better afterwards, better perhaps, than any one ever will again, I think men felt that the chapter on this subject had been closed. The truth was, it had only been opened, for the operation was applicable only to the simple cases and it was necessary to devise new operations for the more difficult cases. We know that even these operators did not succeed in a large percentage of cases, for in many they were obliged to resort to closing the vagina and turning the current of the urine into the rectum.

The great difficulty in handling certain cases of vesico-vaginal fistulae is due to two facts: in the first place, the fistula may be a very large one, and in the second place there may be such an amount of scar tissue surrounding the fistula that its resistance prevents bringing together the parts. In cases of large fistulae with entire loss of the base of the bladder and with scar tissue in the vagina, the old method of operating was to open through Douglas' cul-de-sac, turn the uterus so that its fundus was brought out at the vulva, suture the bladder to the posterior wall of the uterus so that it was made to do the work of the base of the bladder, finally making

a hole in the fundus through which the woman could menstruate. The most important recent finding has been the recognition of the fact that the bladder tissue itself is not often seriously involved in the scar tissue, and that the bladder can be drawn down and sutured to itself so as to close the fistula. This is a very important factor in the treatment of certain of these cases that cannot be treated in the classical way.

A case came to me from New York this fall, upon which an abdominal hysterectomy had been performed for fibroids. There was a large fistulous opening into the bladder, from the vault of the vagina. It was very close to the peritoneum, high up in a virginal vagina, had been operated upon several times and there was an abundance of scar tissue. The edges of the fistula were of such character that I could have no hope of bringing them together and securing union. I opened the abdomen, my intention being to expose the pelvic floor, dissect the bladder away and sew it up. The patient had a very large ventral hernia and, unfortunately for the facility of the operation, was very fat. I opened the abdomen, started on my plan, but in attempting to separate the bladder it began to tear and tore so widely that I saw at once a successful operation as planned would be impossible. I then cut through the top of the bladder to see if I could get at it from the inside, and then freshen and bring the edges together. I could not do this and therefore split right down through the opening to draw the parts together, but I found that this procedure could not be carried out satisfactorily and so I followed this plan which succeeded. The bladder was widely opened, in fact split in half; I found the bladder in front of the fistula fairly movable and I continued the denudation directly down, starting with the bladder walls above and then, passing some catgut sutures, bringing the wounds together. I had thrown out of use a little of the bladder at the sides of the fistula. I then put a drain through the vagina up into the peritoneum and closed up the hernia, which was an extensive one. The patient made an immediate and perfect recovery.

It is a new thing to have gone, by means of a suprapubic incision, through the mucosa of the bladder, drawn the fistula out and closed it by diminishing the capacity of the bladder.

CASE 2. A doctor wrote me from Virginia that he had a case of vesico-vaginal fistula and wanted to know what was the best way to operate upon it. I replied that the best way was to send it up here, as he had had no experience in operating upon such cases. The fistula could not be gotten at from below; I therefore opened the abdomen, separated the bladder, freed the fistula on both sides and brought the edges together with catgut. The result was a perfect recovery.

DR. HALSTED.—In the first case, Dr. Kelly, did you excise the portion of the bladder that contained the fistula?

DR. KELLY.—No.

DR. HALSTED.—What became of it?

DR. KELLY.—It lay up in the peritoneal cavity protected by a drain.

DR. HALSTED.—Does she still have a little fistula?

DR. KELLY.—No, it is all closed up.

**Primary Cancer of the Appendix.**—Dr. HURDON.

Dr. Hurdon presented a case of primary cancer of the vermiform appendix.

Dr. KELLY.—This subject is a large one and it would require a volume to go into it completely and do it justice, so that here one can only outline a few of its important relations. I have been paying close attention to the relation of appendical disease to pelvic diseases for a long time, and the records of our department will show the exact condition of the vermiform appendix in every case in which the abdomen has been opened for about 2 years past.

We meet with appendical disease in a great variety of relationships. We may have cancerous disease of the appendix as in this case, where there was an adeno-carcinoma, which showed no relationship to the pelvic disease; then, again, we meet with cases in which the disease is dependent upon the condition of the pelvic organs. I had within 48 hours, last week, five cases in which I had to remove the appendix.

Where the disease depends upon the pelvic organs, the appendix becomes adherent to the diseased organ, as a uterine fibroid, or an ovarian tumor; these cases we see quite frequently. Then again we meet with a class of cases in which the appendical disease has followed an operation; these are more rare, but quite interesting. After a clean operation, as the enucleation of a diseased tube or ovary, the patient within a few months or a year complains of a pain in the right side, etc. The abdomen is opened and the appendix is found adherent to the seat of the former operation. I have had such a case within the past ten days, where the appendix was pulled out long, and was adherent to the old wound.

It is important to bear this in mind and always inspect the appendix whenever a laparotomy is performed.

This case emphasizes another important fact, that is, how to treat these cases by operation. I believe in the removal of all abnormal appendices, but I do not believe in taking advantage of the opportunity to remove a normal appendix.

*Monday, February 20, 1899.*

**New use for Renal Catheters.**—Dr. KELLY.

I have a brief but important communication to make regarding the further extension of the use of renal catheters.

It did seem a few months ago that certain discoveries were going to limit the use of them. Dr. Neumann, of Guben, found that without catheterizing the ureter he could separate urines and retain them separated in the bladder, obtaining them later from the bladder by means of tubes. This was done by using an instrument of this kind (drawing) which he calls a urine separator. It is a tube with a solid septum running down the centre and projecting beyond the end of the glass tube; the form of the catheter is retained by means of a wire cage. Urine running in this side will run down and discharge at the outer end, and the same for the other side. If we put this instrument into the female urethra and bladder, press it up against the symphysis and then with the index finger in the vagina, push the floor of the bladder against the instrument, we have the floor of the bladder separated into two loculi so that the urine coming out of the right ureter

runs down on one side, and that from the left on the other, thus giving us a simple method without using the catheter.

This was published in October in the *Deutsche medicinische Wochenschrift* and not long after Dr. Harris, of Chicago, was able to use a small staff so as to form two little pockets in which the urine was accumulated and was drawn off by the catheter.

These methods did look at first as if they would very much limit the field of the catheter, but a new and very important use for the catheter has recently arisen.

We all know that some of the most obscure cases with which we have to deal are those in which there is vague but distressing pain in the side, especially the right, and one may long be in doubt as to whether the pain is renal, hepatic, intestinal or hysterical. By means of this catheter, I have been able to include or exclude the kidney. When the upper end of the catheter presses upon the pelvis of the kidney the patient will sometimes tell us that we are touching the very point where she had the pain. Further than that, I have been able to produce an attack of artificial renal colic by injecting solution of boracic acid into the kidney through the catheter. Again, a patient who has been suffering from renal colic will often have afterwards an attack of genuine renal colic following the treatment. I have had two cases recently that are interesting in this connection. In one there was a tumor below the ribs on the right side. Some five or six consultants gathered together to determine what it was, some thinking it to be a tumor of the gall-bladder. I injected fluid and the patient at once complained of pain in the back quite as severe as a genuine attack of renal colic, so we were satisfied that the kidney was in its normal position.

In the other case which occurred not long ago, the condition was so exactly like a large floating kidney that I unhesitatingly made that diagnosis, nevertheless I passed in the catheter first and produced an attack of colic. The patient would not locate the colic in the lump we felt in front but insisted that it was in the back. We then made a median incision to examine the opposite kidney. Instead of cutting posteriorly I cut in the median line and found by the hand that the left kidney was normal, but on examining the other side I found an enlarged gall-bladder in front of the kidney. The induction of the renal colic and location of the pain by the patient thus gave us our correct diagnosis.

There are then, several valuable uses for ureteral and renal catheters in the future, especially to diagnose the cause of pain, particularly in the right side.

Every surgeon must think at once of the chances of introducing infection into the higher urinary tract, and I am extremely careful about introducing catheters in a case where there is much infection.

I have never seen an infection conveyed from the lower into the higher urinary tract by catheterization of the ureters.

**NOTES ON NEW BOOKS.**

*An American Text-Book of the Diseases of Children.* By American Teachers. Edited by LOUIS STARR, M. D., assisted by THOMPSON S. WESTCOTT, M. D. Second edition, revised. (Philadelphia: W. B. Saunders, 1898.)



The second edition of this work is in many respects an improvement on its predecessor. In any work, by so many authors, a certain overlapping of material and variety of opinion on important subjects is to be expected, and compared with similar works by a single author, must seem lacking in uniformity. Under the competent editorial direction of the present volume, however, this defect has been as far as possible eliminated. The entire subject-matter has been revised, many articles rewritten, and some new ones introduced.

Among the latter are "Modified Milk and Percentage Milk Mixtures," "Lithæmia," and a section on "Orthopædics."

The first of these is brief but sufficiently practical for a working knowledge of the important subject.

"Lithæmia" is well discussed by Dr. B. K. Rachford. The author, however, speaks with a certainty of the rôle of the alloxuric bodies hardly warranted by our present imperfect knowledge of the pathology of the so-called uric acid diathesis.

In a short section of twenty-seven pages, Dr. J. E. Moore has condensed much of real use to the general practitioner on the subject of orthopædics. The article is well illustrated and is a decided addition to the volume.

The articles rewritten are "Typhoid Fever," "Rubella," "Chicken Pox," "Tuberculous Meningitis," "Hydrocephalus" and "Scurvy."

Those on "Infant Feeding," "Measles," "Diphtheria" and "Cretinism" have been thoroughly modernized.

In the treatment of diphtheria one expects more emphatic mention of the antitoxin and less of the use of such almost extinct measures as swabbing with hydrogen peroxide, calomel fumigations and the various solvents mentioned.

The articles on hereditary syphilis and diseases of the new-born are very good.

In the light of recent investigation more mention might be made in the articles on cerebrospinal meningitis of the bacillus intracellularis of Weichselbaum. On the whole, however, the book very well fulfills the purpose for which it was compiled—a text-book for students carefully condensed with few omissions, and a reference book sufficiently practical for the general practitioner. The mechanical construction is excellent, and the numerous illustrations instructive.

R. A. U.

Text-Book of Materia Medica, Therapeutics and Pharmacology.

By G. F. BUTLER. Second edition. (Philadelphia: W. B. Saunders, 1898.)

A review of this book was published in the BULLETIN about two years ago. The changes in this edition seem to be very slight, the only notable additions being a table of the "untoward action of drugs" which brings a large amount of very useful information into a small compass and a form convenient for reference.

Annual and Analytical Cyclopædia of Practical Medicine. By CHARLES E. DE M. SAJOUS, M. D., and one hundred associate editors assisted by corresponding editors, collaborators and correspondents, Vol. II. (The F. A. Davis Co., Philadelphia, 1898.)

Volume II of the Annual and Analytical Cyclopædia of Practical Medicine contains some valuable articles on therapeutics; not only are the latest papers and cases cited, but a systematic account of the preparations of the drugs and their physiological action is given; special emphasis, however, is laid upon the untoward action of the drugs and their use in therapeutics. All the most important drugs between bromide of ethyl and digitalis are discussed in this volume, and in most cases with considerable fullness. Thus 22 pages are given to chloroform and 17 to digitalis. Under chloral the various new combinations of this drug with other hypnotics are described and their relative merits discussed. Under bromine and its preparations consider-

able attention is given to bromism and a word of warning raised against the reckless use of these remedies in epilepsy.

Some of the other drugs discussed in this volume are cinchona, caffeine, colchicum, the preparations of copper, curare (which seems to be yielding good results in certain diseases), cubeb, etc. In some cases (notably in the article on digitalis) there is a tendency on the part of the editor to quote freely from the ordinary text-books on the subject rather than from original papers, but on the whole perhaps the most recent views of physicians as to the value and methods of administering the drugs which are discussed in this volume are nowhere better expressed than here.

Essentials of Materia Medica, Therapeutics and Prescription Writing. By HENRY MORRIS. (Philadelphia: W. B. Saunders, 1898.)

This useful little book has now reached its fifth edition. The general plan is the same as in former editions, the chief alterations being the omission of certain parts and the introduction of some of the newer remedies. Welcome additions are the introduction of the metrical, as well as of the apothecaries' system of weights and measures, and a very carefully prepared index. It seems to us that this little work has more value than some of the numerous manuals which though more pretentious are neither fuller nor more accurate.

Saunders' Pocket Medical Formulary. By W. M. POWELL. Fifth edition. (Philadelphia, 1899.)

This book contains over seventeen hundred prescriptions arranged alphabetically according to the diseases to be treated; these formulæ are taken from a great variety of sources—text-books and manuals of therapeutics, medicine, surgery, obstetrics, the various specialties, from original papers, and not a few from various hospitals. The book also contains tables of doses, incompatibles, antidotes, gargles, inhalations, a "surgical remembrancer," a diet table, obstetrical tables, etc., all arranged in such a way as to make consultation of it as easy as possible. It is remarkable how much information the author has succeeded in getting into so small a book.

The Anatomy of the Central Nervous System of Man and of Vertebrates in General. By LUDWIG EDINGER. Translated from the Fifth German edition by WINFIELD S. HALL, PHILIP LEON HOLLAND and EDWARD P. CARLTON. 445 pages. 258 engravings. (F. A. Davis & Co., Publishers, 1899.)

Great productive activity has characterized of recent years the study of the anatomy of the nervous system. Even the investigator devoting his whole time to the subject finds it almost impossible to keep thoroughly acquainted with the results of others in the same field, and any text-book grows old so fast that revised editions of it appearing only a few years apart, have to be so much rewritten as to seem like new books.

The two authors who have been most successful in seizing from the great mass of ideas and facts annually brought forth materials wherewith to build clear and definite representations of modern neurological conceptions are Van Gehuchten of Louvain, and Edinger of Frankfurt. The former writes mainly from the point of view of outline schemes based upon the neuron concept. Edinger, on the other hand, while utilizing both the neuron doctrine and outline schemes, is concerned rather with the form relations of the anatomical mechanisms of the nervous system. His illustrations have, many of them, the rare merit of suggesting real structures and the third dimension. He has been especially interested in comparative studies. In the preface to the second edition, quoted in the fifth, he writes as follows:

"There must be a number of mechanisms which are present in all vertebrates: those which make possible the simplest expressions of the activity of the central nervous system. It is only



necessary to find that animal or that stage of development in any animal in which this mechanism appears in so simple a form that it may be completely understood. Once any one has anywhere perfectly established the relation of such a mechanism, *e. g.* a nerve bundle or a cellular structure, he is able usually to find it again, even where, through adventitious matter, it is made more or less obscure. The discovery of such fundamental features of brain-structure appears to be the next and most important task of brain morphology. Once we know them it will be easier to understand the complicated mechanisms with which the more highly organized brain performs its function."

The suggestiveness of this point of view, together with a clear and attractive style have rendered Edinger's book deservedly popular. Successive editions have rapidly followed one another, the first, quite a small volume, appearing in 1885, the fifth, greatly enlarged, in 1896. The book is now divided into three parts.

Part I is introductory. In forty pages a clear, interesting and concise description of the fundamental ideas accepted by most modern neurologists, is given.

Part II gives a review of the embryology and the comparative anatomy of the vertebrate brain. Something over 100 pages are given up to this subject. It is especially attractive because of the author's personal researches in this line.

Part III treats of the structures found in the mammalian, especially in the human brain. To this nearly two-thirds of the book is devoted. Text and illustrations serve to make this intricate subject uncommonly clear.

The translation is for the most part fairly satisfactory. The illustrations have been well reproduced. The book should meet with the welcome reception it so richly deserves. B.

*The Pocket Formulary for the Treatment of Disease in Children.*

By LUDWIG FREYBERGER, M. D., Vienna. M. R. C. P., London. M. R. S. C., England. (*Rehman Publishing Co., London, 1898.*)

As is stated in the preface the object of this little book is to give the busy practitioner and senior student of medicine, in a concise and handy form, all of the information which may be required as regards the treatment of diseases of children by drugs.

The greater part of the work is taken up by a list of remedies, arranged in alphabetical order, which are best suited to the treatment of children's diseases, and each drug accurately but briefly described as to its properties, source and dose. The scheme which has been adopted in the discussion of the various remedies is as follows: Properties, under which are mentioned the source, ingredients, methods of preparation, etc.; Use, whether internally or externally, and for what; Therapeutic dose, in both English and French (metric) system; Incompatibilities, Correction of Taste, followed by one or more formulæ which, in the author's opinion, are the most suitable modes of administration of that particular drug. The Appendix contains formulæ for sprays, gargles, hypodermic injections, enemata, and suppositories, and the Therapeutic index, which completes the volume, contains an alphabetical list of the diseases of infancy and early childhood, together with the special remedies, which are indicated in each affection.

The book is of a convenient size and of suitable binding to be carried in the pocket, and cannot fail to fulfill the mission for which its author has put it before the profession.

*A Text-Book of Mechano-Therapy:* by AXEL V. GRÄFSTROM, B. Sc. M. D. (*Philadelphia: W. B. Saunders, 1899.*)

This little book is designed for the use of medical students and trained nurses. There is a strong need for a concise presentation of this subject. In part, it is well supplied here. The book throughout is dignified in tone. Its average merit is more than fair, but its execution is unequal, and many details are open to criticism.

The work treats of both Medical Gymnastics and Massage. A synopsis of the Swedish movement system constitutes the first division. The classification here is especially to be commended, and stands in contrast with much of the discursive and sometimes bewildering literature of this subject. The movements are graphically described, and with or without practical demonstration will serve as a competent guide or reference book to the student. It is to be regretted that in the second division of the book, which relates to Massage, the nomenclature which has become classic through use in the best schools and by the best writers, has been abandoned. Further, while it is of course impossible to master the detail of technique from text-books only, the chapter which treats of it will be little help to the novice. The illustrations of a patient's position while undergoing a kneading of the abdomen is, indeed, distinctly incorrect. At most it can be said that there is furnished here a working basis solely for teachers. The chapter on General Massage is negative, and falls short of the requirements of teachers or scholars. There should be outlined, as was shown to be possible in the Swedish movement system, a definite and recognized system of massage—like that of Dr. S. Weir Mitchell, or of the Swedish or the German school. This outline should include directions as to the position of the patient and of operator; and something of the action of the hand and of its relation to the presented surface.

The concluding chapters, which treat of the application of mechano-therapy to the treatment of disease, aside possibly from the omission of some practical suggestions, are exceptionally thorough, although necessarily and intentionally condensed.

It is interesting to find here included, among the applications of mechano-therapy, the treatment of hernia by taxis, and the kneading of the uterus after labor to maintain contraction—all legitimate forms of massage and very properly so considered.

*Foundations of Zoology.* By WILLIAM KEITH BROOKS. A course of lectures delivered at Columbia University, on the Principles of Science as illustrated by Zoology. (*New York: Published by the Columbia University Press by The MacMillan Co., 1899.*)

The theme of most of the thirteen lectures is the nature of life which, rather than the physical basis of life, is held to be the foundation of zoology. Huxley's statement that protoplasm is the physical basis of life, leaves out of account the essential idea of fitness as an attribute of such a basis, and the nature and origin of this fitness form the subject of a large part of the discussion.

The author in approving Spencer's definition of life—the continual adjustment of internal to external relations—elaborates it by considering in more detail the nature and effect of external relations or environment, all of which he includes in the term "nurture." "Life is response to the established order of nature." In nature each stimulus which may call forth a response is a sign with a significance, and life is the use of the ability to read and act on these signs—to read the language of the environment.

From this he passes on to show that the nature of the response depends on what, in the experience of the ancestry was found beneficial, and here he develops in an interesting way a reconciliation between the opposing ideas that the development of the complicated nature of an organism with its ability to respond to stimuli is due on the one hand to the inherent potency of the germ, or on the other to response at each stage of its embryological development to external stimuli, by the idea that were we to know exhaustively the nature of the germ, we might see that the responses made to the external stimuli were no more than, from the nature of the germ, we might expect. From all this it is plain that the beneficial result of interpretation and response to stimuli depends on whether the stimuli or signs have the same significance as they had in the time of the ancestors.

These ideas are based on the essential conception that those

animals which do not respond to stimuli properly, in the end die out, and the ability to respond is continued from one generation to another, not by the inheritance of the results of individual adaptation, but by the inheritance of the adaptive mechanism, which is in the end the object of the selective process. Do we exaggerate the importance of the adaptive mechanism when we say that we acquire no nurture except that which our nature provides for? Life is, perhaps in each individual case, an acquired art, and the adaptive mechanism the inherited thing, and the basis of our expectation of what the organism will do under certain stimuli. In other words, except for the guiding influence of the adaptive mechanism, the influence of nurture will be fortuitous in its effects.

It seems to appear from this that as physical modification is, in the end, dependent on the function demanded for the existence of the species, the adaptation must occur in the active relation to environment, i. e. the response to stimuli, and this response depends on the adaptive mechanism which is inherited and competent as long as the environment is essentially that for which in the ancestors the adaptive mechanism was prepared by selection. As soon as this environment changes selection must again intervene and modify the adaptive mechanism.

The views of the Lamarckians are discussed with no great forbearance, and their absurdity especially brought into relief by the idea that "the probability that haphazard effects of nurture will be injurious is prodigious—even if they are inherited, they will probably not chance to be beneficial independently of selection—the chances are, therefore, against adaptive modification by the direct action of the environment."

The effects of nurture are to be distinguished from those of ancestry, and here there is introduced an interesting conception of the genealogical tree; for while most writers speak of a geometrical progression in the increase of ancestors, as we go further and further back, Prof. Brooks shows that these diverging lines, after a little, essentially converge, and that if we go back far enough the part of ancestry of an individual is rather like a long thread with frayed edges, and from this he deduces the origin of a species from a very few individuals—perhaps one, whence the origin of genera from individuals, and of the metazoan from one protozoan. He pictures the development of the individuals of the bottom fauna from the pelagic in the ancient ocean—their growth in size and powers, so that they subsisted on their ancestors, and traces the peopling of the earth from these. Even to-day the existence of animal life in the sea is still ultimately dependent on the most minute pelagic creatures, which form their food. He gives a most vivid account of the tropical marine fauna, impressing on us the extraordinary absence of vegetable life in those depths, and the fierceness of competition in the bottom faunas as compared with the pelagic—the larvæ of animals living on the bottom become pelagic in the deeper part of the ocean, because otherwise they would be devoured by their parent's neighbors.

The author goes on to the discussion of the argument from contrivance in creation as opposed to the evolution of beings—the consideration of the teleological explanation of creation. As to the 'eternal paradox about necessity and freedom he, as an humble zoologist, who admits his accountability, is quite content to leave to Milton's fends the discussion of 'Fixed fate, free will, foreknowledge absolute.'"

As to the manner of the creation he attempts a reconciliation of the views of Darwin, Gray and Huxley in the wider teleology of Huxley. He does not wholly agree with Huxley in considering that the argument of Paley that the contrivances of human artificers prove nature a contrivance and the work of an artificer has received its death blow in natural selection, but thinks that Paley's argument is rendered inconclusive.

The lectures are concluded with a consideration of the work of Agassiz and that of Berkeley. Agassiz's idea of the wider teleology—that "it is not because we find contrivances in nature that

because the order of nature is one consistent and harmonious whole that he holds it to be intended"—was, of course, pre-Darwinian. He considers all the data of natural science as a language in which the creator tells us the story of the creation, and Berkeley too, finds in the signs to which in life we learn to respond, as stimuli, the parts of a language which we come unconsciously to read and know—in which the creator reveals to us the intentions of the creation.

The book is interesting in its breadth of conception and clearness of style. While in the main a criticism of the theories expressed by previous writers many of the theses are based on the profound knowledge of biology of the writer himself, and we cannot but think as we follow his convincing reasoning, that we have before us the latest addition to American classics in scientific literature. W. G. M.

**The Mineral Waters and Health Resorts of Europe. Treatment of Chronic Diseases by Spas and Climates, with Hints as to the Simultaneous Employment of Various Physical and Dietetic Methods. Being a revised and enlarged edition of "The Spas and Mineral Waters of Europe."** By HERMANN WEBER, M. D., F. R. C. P., and F. PARKER WEBER, M. D., F. R. C. P. With a map. (London: Smith, Elder & Co., 1898.)

The title of this enlarged and revised edition of a well-known work, states in a general way its scope and purpose. It is, however, more than a mere description of the various European sanatoria; it includes a general account of the therapeutic uses of water that, in itself, will be found a valuable guide to the many who wish to utilize this agency. The usefulness of health resorts, as the authors claim, is not overstated, and all the accessories to the water cure are fairly stated and valued; it would be a very excellent thing had we some work of this kind on American health resorts.

Two new chapters have been added, besides the general revision; one on sanatoria other than hydropathic ones, and one on the different diseases in relation to the selection of mineral waters, climatic and other cures, etc. The latter is quite lengthy and full; the former hardly as much so as it might well have been made, or as the subject deserved. Considering the importance attributed to it at the present time, the space given to sanatoria for consumptives, (only about four pages), is not by any means as much as could well have been devoted to it. There is already quite a growing literature of the subject, and it seems likely to have a larger share of professional and other attention in the near future.

The bibliography at the end of the book, though not exhaustive, is quite lengthy, and will be found useful for reference.

**Atlas of Syphilis and the Venereal Diseases, including a brief Treatise on the Pathology and Treatment.** By PROF. DR. FRANZ MAIER. English translation from the German. Edited by L. BOLTON BAILEY, M. D. Seventy-one colored plates. Cloth, \$3.50 (Philadelphia: W. B. Saunders.)

This admirable little volume deserves a wide circulation. The full page colored plates, from original water colors, are remarkably well executed for a work of such popular price. The various manifestations of syphilis are taken up in order of their development, and together present a vivid pictorial representation of the disease. The lesions of chancroid, bubo, condylomata, etc., are given much less space, but are well shown. The appended treatise, while necessarily brief, is only fairly well done, and the methods of treatment are not such as would find favor in this country. To treat syphilis solely by injections which are discarded almost as soon as a disappearance of the symptoms occurs, and only resumed in their reappearance, seems to us irrational, as well as dirty, and tedious. Since the author omits the protoidium from



the preparations of mercury used in syphilis, and remarks that the "best way is to give the patient a bottle of potassium iodid and let him *prepare it himself*," we are not surprised at his failures in the internal treatment of syphilis. H. H. Y.

The Office Treatment of Hemorrhoids, Fistula, etc., without operation, together with remarks on the relation of diseases of the rectum to other diseases in both sexes, but especially in women, and the abuse of the operation of celostomy. By CHARLES B. KELSEY, A. M., M. D., etc. (1898, *E. R. Pelton, N. Y.*)

The title of this little book would lead one to suppose that some new and simple method of treatment is to be promulgated, and the reader is fed on glittering generalities, medical anecdotes and chit-chat, until finally a time comes for divulging the long-expected panacea, when the whole subject is dismissed with the remark that there is not time to describe the plans of treatment.

The author asserts that he prefers always a "straightforward," truly surgical operation, such as "laying open the bones for fistula," and "clamp and cautery" for hemorrhoids. All surgeons, however, would hardly agree with his idea of "straightforward" surgery. For one, we would protest against the widespread usage of such barbaric and unsurgical treatment as the clamp and cautery. The cautery was, doubtless, a valuable surgical instrument before our forefathers learned how to ligate vessels, but since that date its use has been discarded by all surgeons except the pile specialists.

It has been clearly shown by Quéme that hemorrhoids are due to a general phlebitis of the inferior hemorrhoidal plexus—around the entire anal circumference; it is evident that burning off a more prominent lobule here and there does not eradicate the disease. This is proven by the frequent recurrence or development of piles in areas not burned—that is, from diseased vessels left behind.

How representative surgeons can prefer such crude methods to the beautifully exact, radically truly surgical and absolutely curative procedure known as the Whitehead operation, it is hard to understand. To say that the latter method is difficult, hemorrhagic and tedious, is a confession of inferior operative ability.

This little volume is divided into three parts—the first being a description of that "office treatment" which eludes the reader at the last moment. The second part is an exhortation to young would-be rectal specialists to consider the broadness of their chosen specialty, and not to worry over the narrow limits of their pasture.

I will quote at length, as the line of argument is interesting as showing how a specialist entering the body at one little "locus minoris," so to speak, may gradually claim, by propinquity, and sympathy, sovereignty over the larger part of the body. It reads:

"Would any of you admit to a patient that, although your specialty called upon you to be able to operate upon an abscess opening into the bowel at one point, you did not feel competent to operate upon another opening a little higher? . . . Are you equal to a resection of a stricture six inches up the bowel and not at twelve? . . . Do you wish to take the position that you can suture the bowel to the skin, but cannot suture one cut end to another, that it is your business to remove tumors from the rectum which are pressing upon the uterus, but not tumors of the uterus pressing upon the rectum?

"So you will find the path of practice opens into many broad fields of study and interest, and my advice is to follow them for your own sake . . . then you have a specialty broader perhaps than any other, and certainly affording ample scope for all of your powers of study and thought."

The last part, which deals particularly with excision of the rectum, as against colostomy, is good surgery, and reflects credit on the author, whose previous good reputation is not enhanced by the previous chapters.

## BOOKS RECEIVED.

*Annual and Analytical Cyclopædia of Practical Medicine.* By Charles E. de M. Sajous, M. D., and one hundred associate editors assisted by corresponding editors, collaborators and correspondents. Volume III. 4to. 1899. 600 pages. The F. A. Davis Co., Philadelphia.

*The Medical Annual and Practitioner's Index.* Seventeenth year. 1899. 12mo. 879 pages. John Wright & Co., Bristol.

*The Anatomy of the Central Nervous System of Man and of Vertebrates in General.* By Prof. L. Edinger, M. D. Translated from the fifth German edition by W. S. Hall, Ph. D., M. D., assisted by P. L. Holland, M. D., and E. P. Carlton, B. S. 1899. 8vo. 446 pages. The F. A. Davis Co., Philadelphia.

*Atlas of the External Diseases of the Eye, including a brief treatise on the Pathology and Treatment.* By Prof. Dr. O. Haab, of Zurich. Authorized translation from the German. Edited by G. E. de Schweinitz, A. M., M. D. With 76 colored plates and 6 engravings. 1899. 12°. 228 pages. (Saunders' Medical Hand Atlases.) W. B. Saunders, Philadelphia.

*An Epitome of the History of Medicine.* Based upon a course of lectures delivered in the University of Buffalo. By Roswell Park, A. M., M. D. Second edition. Illustrated. 1899. 8°. XIV+370 pages. The F. A. Davis Co., Philadelphia.

*Practical Materia Medica for Nurses.* With an appendix containing poisons and their antidotes, with poison emergencies; mineral waters; weights and measures; dose-list; and a glossary of the terms used in materia medica and therapeutics. By Emily A. M. Stoney. 1899. 8°. 306 pages. W. B. Saunders, Philadelphia.

*Twentieth Century Practice.* An International Encyclopedia of Modern Medical Science by Leading Authorities of Europe and America. Edited by Thomas L. Stedman, M. D. In twenty volumes. Vol. XVI. Infectious Diseases. 1899. 8°. 785 pages. Wm. Wood & Co., New York.

*Statistical Atlas of the United States. Based upon Results of the Eleventh Census.* By Henry Gannett. 1898. Fol. 69 pages. Government Printing Office, Washington, D. C.

*Municipal Architecture in Boston.* From Designs by Edmund M. Wheelwright, City Architect, 1891-95. Edited by Francis W. Chandler. 1898. Fol. 2 Vols. Bates & Guild Company, Boston.

## (REPRINTS.)

*Bacillus Capsulatus (Bacillus Pneumoniae of Friedlaender?) With Especial Reference to its Connection with Acute Lobar Pneumonia.* By Joseph J. Curry, M. D. Reprinted from the Journal of Experimental Medicine, Vol. IV, No. 2, 1899.

*Report of Experimental work on the Dilution Method of Immunization from Rubies.* By Follen Cabot, M. D. Reprinted from the Journal of Experimental Medicine, Vol. IV, No. 2, 1899.

*The Thermal Death-Point of Tubercle Bacilli in Milk and some other Fluids.* By Theobald Smith, M. D. Reprinted from the Journal of Experimental Medicine, Vol. IV, No. 2, 1899.

*Hemorrhagic Septicæmia in Man Due to Capsulated Bacilli.* By W. T. Howard, Jr. Reprinted from the Journal of Experimental Medicine, Vol. IV, No. 2, 1899.

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# BULLETIN

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### THE PRESENT ASPECT OF SOME VEXED QUESTIONS RELATING TO TUBERCULOSIS, WITH SUGGESTIONS FOR FUTURE RESEARCH WORK.\*

BY E. L. TRUDEAU, M. D., *Saranac Lake, N. Y.*

*Gentlemen* :—I venture to say a few words to you to-day on some of the vexed questions connected with the study of tuberculosis. Any of us who can look back some twelve or fifteen years can bear testimony to the progress which has been made by experimental research in our knowledge of this disease. Viewed in the light of the past it would seem that the future is full of promise as well as of unsolved problems. It is not, however, of the past triumphs of the experimental method that I wish to speak so much as of some of the as yet unanswered questions relating to tuberculosis which confront us at every step, and on which we so greatly need light before we can hope for larger results in staying the ravages of this widespread disease. I venture, also, to make a few suggestions as to what seem to me to be the most promising lines for future work in relation to the etiology, pathology, prophylaxis, bacteriology, diagnosis and treatment of tuberculosis.

#### ETIOLOGY.

In regard to etiology, we need to know more as to the cause of the wide variations in the manifestations of the disease.

\* A Lecture delivered at the Johns Hopkins Hospital, on May 1, 1899.

Are these due to differences in the virulence of the infecting germ, to variations of the resisting power of the tissues, natural or acquired, or to both these factors?

What constitutes virulence in the infecting bacilli? Is it due to an increased capacity for elaborating toxins in greater quantity, or to the elaboration of more highly toxic products by the microbes, or does increased virulence depend merely on an inherent capacity of the germ to grow and spread more rapidly in the body?

In this connection I may state that, in my experience, tuberculin made from the culture fluid in which bacilli attenuated by long cultivation have grown is apparently as efficient in producing the usual tuberculin reaction in tuberculous men, and in killing tuberculous animals, as tuberculin derived from the most virulent cultures.

We need more light of an exact nature in regard to the various channels by which the bacillus gets access to the body, and in this connection it may be noted that the large proportion of cases presenting adenoid growths in the nasal fossæ which react to tuberculin would indicate that this portion of the respiratory tract is more frequently a channel of primary infection than is generally recognized.

What is predisposition? It may be individual or racial. Individual susceptibility may be inherited or acquired. It is, in either case, greatly influenced by all factors which tend to produce lowered vitality and imperfect nutrition, and which may be grouped under the terms heredity and environment. A susceptibility to the disease may be inherited; an unfavorable environment may precipitate infection, whereas a favorable one may avert it and even arrest and cure the disease when it has begun to develop. Racial susceptibility presents to the experimenter many curious problems for study which show that the line which divides immunity from susceptibility is a narrow one. Thus we find chickens highly susceptible to infection with the avian variety of the tubercle bacillus, while they resist inoculation with the bovine and especially the human bacillus. Indeed, so insusceptible are they to the human bacillus that they resist feeding for months on tuberculous sputum, and I have made repeated intra-peritoneal inoculations of large quantities of the most virulent cultures of human bacilli in a great number of chickens without the slightest deterioration in health resulting, and these birds when autopsied showed no trace of the injections or any evidence of disease in any organ. The guinea-pig, on the contrary, succumbs readily to inoculation with human bacilli, and is killed even more quickly by the bovine variety, but resists injections of avian cultures, which produce generally only a local ulceration in these little animals. The rabbit, on the other hand, is killed by all three varieties of the tubercle bacillus. Some slight artificially-produced variations, however, may efface the resistance of the chicken to the human, and that of the guinea-pig to the avian bacillus. Nocard<sup>1</sup> has recently reported that by cultivating for some time human tubercle bacilli, enclosed in celloidin capsules within the peritoneal cavity of chickens, he could obtain cultures which not only grew well within the capsules when in the peritoneum of these birds, but had acquired the power of killing them when inoculated in the usual way. Although the guinea-pig resists infection with avian bacilli, Dr. Baldwin has noted at the Saranac Laboratory that this variety of the tubercle bacillus if passed through several rabbits, which it kills by intravenous injection in about twenty-five to thirty days, has become so altered that it has acquired virulence for the guinea-pig, and will then kill these little animals as well as the human bacillus does.

#### PATHOLOGY.

Among the problems in pathology which require to be studied are:

(a.) The chemical changes in the quality of the digestive secretions, ptyalin, pepsin and trypsin, which in common with the infectious diseases occur in tuberculosis, and their immediate causes.

(b.) Further studies of the blood in tuberculosis. The cause of the anemia in this disease; whether due to the effect of the toxins directly on the blood cells or the blood forming tissues, or indirectly on the nerve centers, and the nature of this process.

(c.) We also need light on the exact pathological changes which result in cure in peritoneal tuberculosis after lapar-

tomy, and the mechanism by which tubercle bacilli (usually so resistant to the action of the tissues) are disposed of in the cure which follows this operative procedure. Does tubercle represent a defensive effort on the part of the organism, or is it a nidus which favors the multiplication and subsequent dissemination of the germs? What are the causes which lead occasionally to the entire disappearance of the bacilli before death in acute miliary tuberculosis from the tuberculous lesions of man and animals, and what evidence is there that we may interpret this disappearance as indicative of an acquired immunity?

(d.) What are the factors determining local immunity in the tuberculous? Is it true, as Koch pointed out, that the tuberculous individual is relatively immune to reinoculation with the virus (just as the syphilitic cannot be reinfected during the active progress of the disease)? How are we to harmonize this view with (i) local extension of the disease; (ii) extension of disease in other regions, *i. e.* development of laryngeal secondary to pulmonary tuberculosis?

(e.) Very divergent opinions are held by capable observers with regard to the meaning of the presence of tubercle bacilli in milk, semen, urine, etc. The majority are of the opinion that wherever they are present in the excretions there must be active tuberculosis in the excreting organs. On the other hand, a large number of cases are on record in which no such tuberculosis has been discovered; and the conclusion reached is that the actual excretion of bacilli by the kidneys, mammary glands, testes, etc., may occur. The question ought to be settled, *i. e.* by intravenous inoculations and observations upon the secretions at successive periods to determine (i) the earliest period at which the bacilli are discoverable in the secretions; (ii) the possible taking up of bacilli by endothelial and gland cells in the excretory glands; (iii) the difference, if any, in the appearance and properties of bacilli cast off by ulceration into the secretions and those truly excreted.

(f.) The production both within the body and outside of "beading" of the tubercle bacilli; its meaning; whether such beaded forms are degenerate or resistant forms (due to reaction of bacilli towards body fluids); relationship, if any, between beading and spore formation; what is the true nature of the tubercle bacillus? Is it a bacillus at all?

#### PROPHYLAXIS.

We need still further studies on the various sources of infection. Until recently we have looked upon the dried sputum of pulmonary tuberculosis, the dejections from the bowels of patients suffering from tuberculous enteritis, and the milk of tuberculous cows, as practically the only sources of infection to be guarded against. That the dried sputum is not the only source of danger has been shown by the recent work of Flügge,<sup>2</sup> who has demonstrated that the throat and mouth secretions of most tuberculous patients when atomized by the act of coughing may be a real source of infection to those about them. Some method of determining to what extent this source of danger exists, and which types of cases are most apt to thus spray bacilli about them in fine particles of saliva or throat mucous, would be of great value to preventive medicine.

Dr. Baldwin's<sup>3</sup> studies at the Saranac Laboratory have also shown that the hands of patients using handkerchiefs may, in the majority of cases, be the carriers of unsuspected bacilli.

Practical suggestions as to the education of the masses in regard to the sources of infection, and studies which will give us more light on the best and most practical methods to guard against them, would be of inestimable value. Under this head would be comprised practical suggestions as to the care of dust in living rooms, cars and public buildings, and better methods of the disinfection of these places by artificial means; as well as improved plans for ventilation and light in buildings, and the general dissemination among the masses of a better knowledge of personal hygiene.

A most promising prophylactic measure would be the establishment of state and municipal sanatoria in favorable localities for the treatment of incipient cases, and of special hospitals on the outskirts of large cities for the care of advanced and hopeless ones. It does not seem unreasonable to hope that a general adoption of this plan would in itself materially reduce the mortality from tuberculosis directly by curing a fair proportion of cases, and by the educating patients as to the care of their health, and indirectly by removing from crowded communities a large number of individuals who are a constant source of danger to those about them. More facts bearing on sanatoria, their location, construction, equipment and administration, would be of inestimable value.

The production of relative immunity by preventive inoculation belongs to the field of prophylaxis, and offers a most enticing subject of study; but I will refer to this more fully later on.

#### BACTERIOLOGY.

Studies relating to artificial methods of exalting and attenuating the virulence of the tubercle bacillus are much needed, as they bear directly on the possibility of producing artificial immunity by preventive inoculation, and of obtaining an efficient antitoxic serum for the treatment of the active forms of the disease. Other bacilli, like the smegma bacillus and the bacillus of timothy-grass, which present nearly the same morphological appearances, the same peculiar reactions to staining methods as the tubercle bacillus; the bacteria which produce pseudo-tuberculosis, offer a most interesting field for further research.

Further light on tuberculin, the best methods of obtaining this toxin of standard strength, the influence of the virulence of the germs from which it is produced, and of the culture medium on which they grow, the technique of manufacture, etc., would be of great value. Dönitz<sup>4</sup> has recently shown that specimens of tuberculin obtained from different sources vary in strength as one in three.\* In relation to this subject my own observations so far have tended to the belief that as effective a tuberculin can be made from attenuated as from virulent cultures, but as the non-virulent cultures grow

generally more luxuriantly it may be that they produce more toxin, though of less potency, while the virulent germs elaborate a more toxic product but less in quantity.

It is greatly to be desired that physiological chemistry shall separate the various substances elaborated by the bacilli or contained in their bodies, and that the toxicity of each of these shall be determined and their influence on the cell and the living animal studied. Researches in this direction have been begun by Drs. Levene and Baldwin at the Saranac Laboratory. Dr. Levene<sup>5</sup> has already found that "the body substance of tubercle bacilli does not contain any products of the albumin nature; that like the nuclei of cells it consists mostly of nucleoproteids; that one of the nucleoproteids differs from all the other nucleoproteids inasmuch as it is not precipitated by magnesium sulphate (and in this point resembles nucleohiston), and does not give the Biuret test; that it contains nuclein or nucleins as such." The three different proteid substances contained in the bodies of the tubercle bacillus have different coagulation points; the first from 50 to 64°C., the second from 72 to 75°C., the third from 94 to 95°C., the last being very rich in phosphorus. Dr. E. R. Baldwin is about to make some experiments bearing on the toxicology of these three proteids. As such large quantities of dried T. B.'s are necessary for each chemical and toxicological experiment the completion of the work necessarily will require some time. Researches on the chemistry of the tubercle bacillus have also been published recently by Ruppel,<sup>6</sup> working in Behring's laboratory, and by Jules Auclair,<sup>7</sup> from the laboratory of Professor Grancher.

A most promising field of research has recently been opened by the successful cultivation by Nocard of various micro-organisms enclosed in celloidin capsules and inserted into the peritoneal cavities of living animals. These little celloidin cells allow to a limited extent the passage of some of the animal fluids into the capsule, thus affording a sufficient pabulum for the growth of the germ while protecting the microbes from the direct action of the body cells, and also permit the toxic substances elaborated by the bacteria to pass through and be taken up into the general circulation, while egress of the germs and their dissemination throughout the system of the animals is prevented. Experiments by these methods offer two very broad fields: the study of the influence of cultivation under such conditions upon the germs, their virulence and their products, and the study of the effect of freshly and continuously elaborated toxins on the living organism while the latter is protected from the direct pathogenic consequences of the spread of the microbe throughout the system at large. We may hope by this line of research to obtain more light on the mechanism of infectious diseases, and the reactions of the living tissues to the toxic products of the microbes, and it would seem to open new possibilities in attempts at the successful production of artificial immunity and the obtaining of antitoxic substances for the treatment of diseased conditions.

After prolonged cultivation by this method Vincent<sup>8</sup> succeeded in changing the harmless varieties of saprophytes into parasites, which gradually acquired the power of producing toxins, and ultimately of killing animals. Nocard<sup>1</sup> found, as

\*As in the use of tuberculin for diagnosis the test is only a qualitative one, the practical importance of such variations is somewhat lessened.



already mentioned, that the human tubercle bacillus, which is non-pathogenic for fowls, after cultivation within these celloidin capsules which had been inserted into the peritoneal cavity of chickens, acquired after a time the power to kill these animals when inoculated in the peritoneum.

We need further knowledge on the relative pathogenic properties for man of the recognized varieties of the tubercle bacillus, the human, the bovine, and the avian.

#### DIAGNOSIS.

The value of any addition to our knowledge which will enable us to make a positive diagnosis at the earliest possible moment after infection has occurred must be conceded, for the chance of cure depends greatly on the early detection of the disease, and observations in the autopsy room have taught us how often nature can cure tuberculosis in its incipency. We should in many cases no longer be content to wait for the appearance of expectoration containing bacilli, for marked physical signs, or for an unmistakable clinical picture. It seems to me we have in the tuberculin test a most delicate and searching means of detecting tuberculous disease when this cannot be done positively in any other way. We need more exact knowledge concerning the practical application of the tuberculin test in man, and we greatly need more light on the best method of applying this test, its exact value, its errors, their cause, and its possible dangers; in what other pathological conditions the reaction to tuberculin may occur;—and are the reactions which take place with considerable frequency in other diseased conditions due to them, or do they invariably indicate a concomitant and unsuspected tuberculous focus in some part of the body?

We need to know more as to the mechanism of the tuberculin reaction. The most generally accepted theory at present in regard to it is, briefly, that the small dose of tuberculin injected is a partly specific irritant both to tuberculous foci and to the susceptible organism in general. It produces intense hyperæmia of all tuberculous tissue in the body (local reaction), and as the result of this hyperæmia much toxin stored up in the tubercles themselves is thrown into the general circulation and produces fever and the characteristic symptoms which go to make up what is termed "a general reaction." That these poisons stored up in the tubercles are in part at least derived from the dead or weakened bacilli has been shown by the experiments of Babes and Proca,\* who found that if two sets of rabbits be injected with equal quantities of living and dead bacilli the latter react to the tuberculin test at a much earlier period than those inoculated with living germs. This hypothesis that the general reaction is brought about by the toxins already stored up in the tuberculous lesions and exploded as it were by the hyperæmia produced about these lesions as a result of the test injection of tuberculin, is borne out by the fact that a greater amount of albumose can be recovered from the evaporated urine collected during the reaction than was contained in the test injection; also by clinical observations which indicate that patients suffering from localized surgical tuberculous processes of limited extent, and where the vascular supply to the part is limited, require a larger test injection to produce the

reaction than those who have extensive or scattered visceral lesions in highly vascular organs like the lungs.

A very general impression seems to prevail that the tuberculin test is dangerous and tends to aggravate the disease. This impression had its origin, no doubt, in Virchow's statement that the autopsies which he made upon the first patients treated after Koch's method by repeated and increasing doses of tuberculin, so as to produce frequent and violent reactions, revealed in an unusual number of instances the presence of apparently new tuberculous foci at a distance from the original and recognized lesions. It may be conceded that violent and repeated reactions when brought about in patients suffering from extensive visceral disease tend to exhaust the already overtaxed defensive resources of the organism, and may in this way aggravate the disease. But the conditions are very different in incipient cases where the resistance of the patient is as yet but little impaired, and where it is necessary to produce only one moderate reaction. Even if the correctness of Virchow's observations be conceded, the finding of more pronounced and distant lesions may not necessarily mean that the bacilli were disseminated through the system as a result of the tuberculin treatment. We have ample clinical and experimental evidence that the local reaction resulting from an injection of tuberculin makes apparent the presence of latent and unsuspected tuberculous lesions, but no proof has been brought forward to show that the bacilli are scattered through the system or that new foci are produced as a result of such injections.

In a recent study by A. Broden<sup>10</sup> on the Treatment of Experimental Tuberculosis of the Peritoneum in Dogs by Tuberculin Injections, he points out that the extent and number of tubercles visible in the peritoneum when the treated animals are killed at an early stage of the disease are greatly in excess of that noted at the same stage in the controls. On careful microscopical study, however, these large and more numerous tubercles are found to consist of an aggregation of leucocytes, which appear to represent a defensive effort on the part of the system to limit the disease, as the bacilli in them are seen to be very few in number, beaded, and soon entirely disappear, leaving only slight fibrous lesions from which the animal ultimately completely recovers. In the controls killed at the same period the macroscopical appearances show but little evidence of disease, but a microscopical study of the peritoneum reveals everywhere small nodules swarming with large numbers of short, well-stained bacilli, the disease going on rapidly to a fatal termination.

In my experience no injury to the patient has occurred thus far as a result of a test injection of tuberculin where small graded doses at two or three intervals have been used for diagnostic purposes, and all of the hospital physicians with whom I have conversed, who have practiced this method, have apparently had a similar experience, and none, to my knowledge, has abandoned it on account of any evidence of injury to the patient. If we consider the overwhelming importance of this subject in our struggle against tuberculosis, it is greatly to be hoped that a thorough study of the method will bring to light the true facts as to its exact value, and its limitations and possible objections.

The application of X-rays to the diagnosis of incipient pulmonary tuberculosis promises to be of practical assistance, as the height of the excursion of the diaphragm and the appearance of a slight shadow over the suspected area in the lung, when considered together with the rational symptoms and any trifling deviation from the normal sounds in the lung, enable the physician to reach a positive conclusion in many cases before the appearance of expectoration containing bacilli, or the unmistakable symptoms of the disease are present. A case I saw recently with Dr. Francis Williams, of Boston, illustrates the corroborative value of an X-ray examination in early and doubtful cases, and that by a combination of the usual clinical methods with a thorough X-ray examination, a positive conclusion as to the presence or absence of the disease may often be reached before cough and expectoration are present, or any appreciable deterioration of the general health has occurred. I had suspected the presence of tuberculosis in a hospital patient of Dr. Williams' merely because the temperature chart showed a rise of one-half to one degree occasionally in the evening, and because I thought I could detect very slight evidence of consolidation at one apex. These were all the symptoms present. Under the X-ray the case showed that the diaphragm on the suspected side was higher than the normal, and its excursion appreciably diminished on that side, while a slight shadow could be made out at the apex. I suggested the tuberculin test, and the patient had a typical reaction, the temperature reaching 102.5, fourteen hours after the injection.

#### TREATMENT.

The climatic and open-air treatment of tuberculosis in especially constructed sanatoria is at present conceded to offer the patient the best chance of recovery, but this needs elaboration, and studies which would afford more exact indications for such class of cases as to the proper application of rest or exercise, exposure to the air, feeding, hydrotherapy; the use of tonics and reconstitutives, and the regulation of the smallest details of the daily life, would be of great value.

The obtaining of a serum that would be antitoxic for the infections concurrent with tuberculosis would make us much less hopeless in the presence of such cases, while at present we must be contented to rely on fresh air, rest, food and alcohol to relieve this desperate condition.

To laboratory researches we may yet look for some general specific method of treatment, either by preventive inoculation or the production of an efficient antitoxic serum for tuberculosis. It is true that, in spite of the claims so constantly made, little of practical value to the tuberculous patient has been accomplished so far by the enormous amount of research work bearing on attempts to produce immunity in animals against tuberculosis and to obtain an efficient antitoxic serum for the poison of this disease.

To many minds there seems no reason to hope that any efforts tending to the production of artificial immunity in this disease will ever be successful, and it is true that little can be found in the clinical history of tuberculosis which would lead us to believe that such an immunity ever occurs in the natural course of the disease, as recovery from a tuberculous mani-

festation in any part of the body does not seem to afford any protection against a subsequent and often fatal outbreak of the malady. It would be presumptuous, however, in view of the recent advances made in this direction in other infectious diseases, to deny absolutely the possibility of solving this problem, and some experimental evidence is accumulating of late which tends to prove that the resistance of the body to a virulent tuberculous infection can be greatly increased by preventive inoculation.

I will not here review the work done in this direction by Richez, Héricourt, Grancher, Martin and others, as it is no doubt familiar to you, but I will occupy your time by referring, more particularly to my own experience in this direction, not on account of the practical value of the results I have obtained, but because my observations having been made entirely independently seem to add some confirmatory evidence to the partial success already attained by others in this field. In common with many other experimenters, I failed to obtain any appreciable results by preventive inoculations of the various products to be found in liquid cultures or by the inoculation of the bodies of dead tubercle bacilli. I was driven, therefore, to attempt to reach the end in view by making use of the living germs themselves, attenuated by various methods.

The first evidence of any protection which I succeeded in obtaining was in 1893, which I detailed in a paper read before the Association of American Physicians in May, 1894. I found that by subcutaneous preventive inoculations of attenuated living cultures of avian tubercle bacilli I was able to increase the resistance of the rabbit to infection with virulent living mammalian culture. The photographs which I show you demonstrate the degree of immunity obtained. The test inoculations were made in the eye, where the immediate result could best be studied and controlled. The eyes of the controls were gradually destroyed by the progressive tuberculous process, while those of the vaccinated animals, after undergoing a certain inflammatory reaction, returned more or less completely to their normal condition. Unfortunately, many of the animals died of the attempt at vaccination, and complete immunity was manifested only in a few; while in others, similarly treated, the eyes were eventually either partially or totally destroyed. I have also obtained a marked degree of success in protecting guinea-pigs by cultures of mammalian bacilli attenuated simply by prolonged growth on artificial media.

Dr. de Schweinitz<sup>11</sup> was the first to call attention to his results in protecting guinea-pigs by means of living attenuated cultures, and although my results have not thus far been as good as his, my experience in the past four years shows that a very marked degree of increased resistance to tuberculous infection can be induced in these animals, as well as in rabbits, by such preventive inoculation. It is of interest to note that the culture used by Dr. de Schweinitz in his experiments was originally obtained by him from me, and is the same with which my own experiments were made. This culture originated from plants made on serum by me from the lesions of a rabbit infected with human tuberculosis in 1891, and has been grown on various media, principally on the ordinary



glycerin peptone bouillon, either neutral or slightly acid, ever since. I began to notice, after two years' cultivation, that a great majority of the guinea-pigs inoculated with this culture lived for many months beyond the usual time, and the virulence of the germ was evidently decreasing. It was not, however, until 1894 that I observed that many of these animals apparently recovered completely from the inoculation, while a few still died of chronic tuberculous lesions. At present, if twenty animals be inoculated with this attenuated germ, which has been grown for six years continuously on artificial media, with perhaps one or two exceptions, all survive for many months. It has been necessary, however, to keep the pigs for a long time, for occasionally some of them die of chronic tuberculosis even two and a half years after the attenuated inoculation.

What the attenuation of the bacillus is due to is still a matter of doubt in my mind. De Schweinitz is of the opinion that the acid in the media greatly hastens the attenuation, and has therefore grown his cultures on very acid media; but the germ undoubtedly loses its virulence if the cultivation is sufficiently prolonged, no matter what the media may be. I have varied the acidity of the media, but as yet have come to no definite conclusion on this point. In favor of Dr. de Schweinitz's view it may be stated that the tubercle bacillus loses its virulence much more rapidly while growing on potato which is slightly acid, than on serum, but these two media differ also in many other respects besides in reaction.

It is a well-known fact that any living organism loses any attribute which through many generations its environment does not call into use. While living a saprophytic existence the tubercle bacillus has no need for the exercise of that characteristic which is known as its "virulence" and which means the power to cope successfully with the resisting elements of living tissues, and it may be that this attribute is lost to it by its disuse through the millions of generations the germ passes through while growing for so long on artificial media. However that may be, it is certain that the tubercle bacillus is robbed of its virulence with the utmost difficulty. All other methods of attenuation hitherto employed—heat, time, antiseptics, etc.—aim a blow at the viability of the germs sought to be attenuated, but do not alter their biological characteristics. They are either killed, in which case they produce no disease, or else they survive sufficiently to grow in the body and ultimately destroy the life of the animal. Prolonged cultivation, on the other hand, gives us a culture which grows vigorously, but which has lost to a great extent its specific pathogenic powers.

A certain disturbance of health and loss of weight are always caused by the inoculation of this attenuated culture, but the animals after three months seem to have completely recovered. If at this time they are inoculated with virulent bacilli, together with an equal number of controls, the prolongation of life in the vaccinated animals will be apparent in every case. In several lots I have noticed the death of all the controls to occur before a single vaccinated animal had died. Complete immunity, however, has not been attained in my experience so far by this method, although some of the animals have

occasionally lived as long as eighteen months after the virulent inoculation.

I will not weary you with any of the details of these experiments, which are still incomplete, but merely report the gross results which I have obtained thus far in work done on a total of one hundred and twenty-two guinea-pigs. In 36 controls the average life was 57.2 days, and in the 66 vaccinated animals it was 154.3 days, so that the vaccinated animals lived nearly three times as long as the controls. Some of the pigs survived the virulent inoculation as long as eighteen months. This includes all the experiments on guinea-pigs, some of which were made before the germ was very much attenuated. Intravenous inoculation of this attenuated culture protects rabbits to about the same extent, but in them, as in the guinea-pigs, the immunity is relative except in a few cases where the protection seems to be almost complete.

It would seem at first sight that the evidence brought forth by these experiments tends to prove positively that at least relative artificial immunity had been produced in these animals. The evidence is incomplete, however, in so far as it relates to the complete recovery of the animals from the protective inoculation. I have kept vaccinated pigs which lived nearly three years in apparently good condition and yet ultimately died of chronic tuberculosis. It is possible, therefore, that these experiments only prove that the disease is not auto-inoculable, and that an animal in which a very chronic form of tuberculosis has been induced artificially is not susceptible to reinoculation with a more virulent infecting material. This, I believe, is true of syphilis, a disease which closely resembles tuberculosis in its course and various manifestations.

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#### THE JOHNS HOPKINS HOSPITAL BULLETIN.

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# INFUSION OF SALT SOLUTION COMBINED WITH A SPECIAL METHOD FOR THE ADMINISTRATION OF OXYGEN INHALATIONS AS A TREATMENT IN PNEUMONIA.\*

BY CLEMENT A. PENROSE, M. D.

It has been the custom in the Johns Hopkins Hospital for several years to use infusions of normal salt solution (.6%) in cases of collapse, especially during or after severe surgical operations. In such cases the pulse is generally the index to the necessity for infusion or the amount infused.

During my gynecological service in this Hospital I had the opportunity of observing the effects of infusions in a number of such cases, and was much impressed by the fact that in many the stimulation to the respiration was more marked than to the heart. This was true especially of those cases who, taking the anæsthetic badly, were in a more or less state of asphyxia.

The possibility of this respiratory effect being in addition to others of great benefit in conditions like pneumonia occurred to me then, but it was not until I had entered the service of Dr. Osler that the opportunity arose to demonstrate the truth of such speculations. He kindly permitted me, February 14, 1898, to try the effect of salt infusions as a last extremity in a very grave case of pneumonia, to whom later inhalations of oxygen were administered after a special manner. Since then the same treatment was used by me in two other cases of pneumonia; one, on the surgical side following an operation, and the other in private practice.

The infusions of salt solution were given in the usual fashion employed in the Hospital, *i. e.* the salt solution, at a little above body temperature, is poured into a graduated bottle, from the bottom of which runs a long rubber tube. The needles, which are introduced under the breast, or into the subcutaneous tissues of the thighs, etc., are connected with this tube. The pressure is regulated by elevating the bottle or by means of a rubber bulb, with valves, which is attached to the stopper of the bottle, and thus air can be forced into the space above the salt solution. At intervals a careful examination of the heart is made, especial attention being paid to the second pulmonary sound, with instruments in readiness for instant bleeding if this become too accentuated or murmurish in quality. Inhalations of oxygen in connection with infusion are given according to a special method, which is as follows:—in place of the delivery nozzle usually adopted, a glass funnel is substituted, which is held by a framework resting on the bed about two inches from the face, and supplies oxygen to both mouth and nostrils without interfering in any way with the breathing. The oxygen is passed through a wash bottle containing a pint of hot water in which has been placed one dram of an inhalation mixture, the formula of which is:—

R  
Creosoti (beechwood), . . .  $\frac{3}{4}$  ss (one-half ounce.)  
Olei Terebinthinæ, . . .  $\frac{3}{4}$  ss (one-half ounce.)  
Tr. Benzoini Comp. . . .  $\frac{3}{4}$  ii (two ounces.)

The inhalations are given at intervals whenever lips or finger tips become bluish, are continued till the color is normal, usually from ten to fifteen minutes in those who give a good reaction.

The first two cases of pneumonia on which I have tried infusions of salt solution combined with this special method of giving oxygen inhalations died, the last case made a perfect recovery. It should be remembered, however, that all these cases were considered hopeless, and had received the usual treatment for pneumonia before this method was resorted to. Since I left the Hospital, September 15, 1898, this treatment has been resorted to in several other severe cases, and also by physicians in the city in their practice, with most gratifying success. In the two cases that died, the prolongation of life and the relief of symptoms, etc., were so marked that I regretted this treatment had not been employed earlier. From the brief histories which are presented, it will be seen that all three cases represented the severest types of pneumonia with every reason for unfavorable prognoses.

CASE I, J. O., admitted to Ward F (medical) February 12, 1898, on the 5th day of the disease. The patient was an ill-nourished, feeble man of fifty-two years, with a bad alcoholic history, complete consolidation of the right lung, a temperature ranging from 104° to 105.5°, and a muttering delirium, with twitching of the muscles, who in addition had chronic Bright's disease, with almost anuria for two days after admission. The pulse was very weak and wavering, 104 per minute, respiration shallow, labored and ranged about 40 per minute. Dr. Osler saw the patient two days after admission, the day upon which infusions were begun, and said the man was moribund, and would probably not live till night. The results of infusion were most surprising. On the first day, after 2700 cc. salt solution had been infused, the following was noted:—"the pulse became full and regular; the rate however remained about 104, respirations became deeper and fell to 28 per minute." On the second day 4000 cc. more of salt solution were infused. The patient became conscious after three days of muttering delirium, and voided large quantities of urine. The pulse and respirations remained about the same. On the third day 3000 cc. salt solution were used with little effect. The pulse was 112, and respirations 44 per minute.

On the fourth day of treatment 3000 cc. of salt solution were infused. The temperature fell to 100.4°, and the patient had a profuse perspiration. A crisis seemed imminent. Later however the pulse ran up to 140, and respirations to 52, and as considerable cyanosis developed, inhalations of oxygen were given according to the special method mentioned above. Almost immediately the patient's lips and nails became a brilliant red. He went to sleep, and the tongue and mouth were noted to be much less foul. The pulse remained about the same, but respirations fell from 56 to 52 per minute, and

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became less labored. Oxygen was afterwards given at intervals with great comfort to the patient, the inhalation mixtures seeming to have an expectorant action, as the sputum became less tenacious and more watery, due, no doubt, in part to the salt infusion.

On the fifth day (twelfth day of the disease), patient began to fail and required 6000 cc. of salt solution throughout the day, with almost a constant supply of oxygen. The pulse was 140 and very irregular; respirations were 56, and shallow. About noon I bled the patient from the arm and removed thirteen ounces of a dark, quickly clotting blood. This was done because the second pulmonic heart sound became distinctly murmurish. The pulse fell after the bleeding from 140 to 132, respirations from 56 to 32, and again, a good reaction to oxygen was given. The patient lived all day in a semi-conscious condition, but at 9.30 P. M., died very quietly in spite of all further efforts.

The leucocytes in this case fell from 16,000 the day infusions were begun, to 9200 the day of death.

CASE II, Dr. B., admitted June 26, 1898, Ward C (surgical side). The patient was a large, stout man aged fifty-two years; good family history; operated on July 11, for carcinoma of the tongue; right half of tongue removed, with glands of neck, etc. The anæsthetic used was chloroform. Pneumonia followed the operation on the sixth day, due to aspiration of food. It was patchy in character, and scattered throughout both lungs.

On the second day after the development of pneumonia, the patient's condition became so desperate that salt infusion combined with inhalation of oxygen was begun. In this case the same good effects were noted as in the former. In addition, the wound in the neck which, with the half of tongue remaining, had become very foul and offensive, in a few hours became quite clean and sweet. The patient died on the fourth day of the pneumonia, having received 13,000 cc. of salt solution in all. He showed, though in a very low condition, marked reaction to oxygen after being infused.

Up to this time little had been accomplished as far as mortality was concerned, but in one case, I was contending with age and alcoholic history, and Bright's disease, and in the other with an aspiration pneumonia following a severe surgical operation; in both cases the treatment was employed late in the condition and as a last extremity. Recently I have had a case in private practice where the conditions with the exception of age seemed even more hopeless than in the other two, but which has made a remarkable recovery and fully compensates for the disappointment of losing the other two patients after they had shown such evident improvement.

CASE III, Mrs. R., aged 34, married. Delicate constitution; had a slight cold for two to three days, in all probability, an attack of gripe, which was then epidemic. December 16, 1898, while standing before an open window, she felt a stabbing pain in the left side, which increased in severity. She went to bed and sent for the family physician. Her temperature rose steadily, and on December 19, four days later, reached 104°. The patient then became delirious and had, according to her physician, decided flatness throughout the upper left chest. The pulse was weak and thready; respirations rapid and

shallow. The delirium in spite of treatment persisted, and the patient became progressively weaker. I was called in, in consultation, upon December 26, at 10 A. M. Her temperature was then 105.5°, her pulse irregular, 120 and over, very soft and weak, running in character. Respirations varying from 48 to 52 per minute were very shallow and labored; lips and finger tips much cyanosed. The patient was in muttering delirium, with marked twitching of the muscles, especially those of the extremities. The muscles of the neck were somewhat stiff. Her condition was so desperate that a thorough examination was out of the question. However, numerous crackling râles were heard throughout both chests and in the left upper front, the breath sounds had a decidedly tubular character. The back was not examined. 1000 cc. of normal salt solution were immediately infused in the right breast, and inhalations of oxygen were begun by my method, with immediate benefit. Respirations fell to 32 per minute and the twitching of the limbs grew less and the patient regained a normal color in a few minutes. The pulse showed some improvement in volume and tension, but the rate remained still about 120. Inhalations and repeated cold sponges were given all day at intervals, but with little improvement. The temperature fell a degree or so, but the meningeal symptoms became much more marked. At eleven P. M. severe convulsions set in, almost eclamptic in nature, and succeeding one another every three to four minutes. The patient was very blue. 2000 cc. more of salt solution were infused, and eight ounces of blood were removed from the left arm as the second pulmonic sounds had become murmurish. The blood was very dark and clotted immediately on standing. There was now decided improvement; the respirations fell from 48 to 24 per minute (just one half), and the oxygen which had apparently been of little service all day, in a short time gave a good reaction. The lips and nails became a good color; respirations steadily grew deeper and less labored. The tongue and mouth became cleaner and more moist, the pulse steadier and fell to 104 per minute. The convulsions gradually disappeared.

December 27, 4.30 P. M. The patient is much better, is conscious after eight days of muttering delirium. The temperature is 105.5°. She takes nutrition well, has voided much urine, and perspired freely. 600 cc. more salt solution were infused, and the rectum was irrigated with large quantities of this solution also. Oxygen was given at intervals to the patient more for her comfort than because of cyanosis. Mouth and tongue continued moist and clean; the breath was sweet, with a strong odor of the inhalation mixture.

December 28. Temperature 102°; general condition much better; pulse is full and strong, regular and 117 per minute; respiration only 30, quiet; oxygen is now discontinued. From this time on the patient steadily improved; the temperature fell gradually by lysis, and on January 14, was normal. She has now fully recovered, has gone to the country, and has already gained several pounds. I consider this a remarkable case, a veritable resurrection, and which fully repays one for the time spent in vain on others. With such a high temperature, with muttering delirium for eight days and later convulsions, with gripe as a precursor to the pneumonia, in a naturally delicate woman, I am sure all will agree that the

prognosis was more than bad. The blood in this case was negative for the Widal typhoid test, the urine showed a considerable number of pus cells from a leucorrhœa, but no casts, etc.

In conclusion. I claim that the infusion of salt solution in pneumonia is a decided advance in its treatment if used by those familiar with the significance of the second pulmonic heart sound, and who are prepared to bleed immediately if this indicates danger. In my opinion, infusion, which is slower, is preferable to transfusion. It dilutes the toxins in the blood, relieving delirium, etc., and promotes their elimination through the sweat glands and kidneys. It lowers the temperature. It stimulates the heart. It lowers the rate of respirations and renders the breathing less labored. It seems undoubtedly to render the patient more susceptible to the influence of oxygen.

The use of a funnel in the administration of oxygen held by a framework has these advantages:

The patient gets oxygen through both the nostrils and mouth. There is no impediment to expiration, as is the case with a nozzle in the nose or mouth. The patient may go to sleep and still take the oxygen, which they frequently do, whereas the nozzle being uncomfortable and producing a blast, is apt to keep them awake. The passage of the oxygen through a hot inhalation mixture is more beneficial than when used alone. The vapors from such a mixture carried over with the oxygen certainly render the tongue and mouth less foul, the breath sweet, and promote expectoration,—and who can say it does not have some antiseptic effect on the lungs?

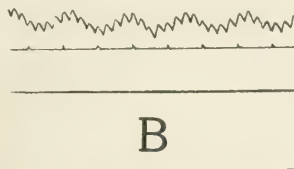
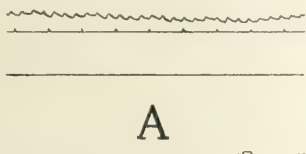
Oxygen alone being odorless, a patient if conscious will make greater efforts to breathe something which is tangible, and will not turn the head away, etc.

That cases which have been previously infused with salt

solution react much better to oxygen has certainly been my experience. I have tried oxygen alone in several cases of pneumonia, and have the notes of the same with me, but not one, although representing pneumonias of a much less severe type, gave the remarkably quick reaction noted in the three cases where infusions of salt solution had been previously given. Oxygen, it is known, is held in the blood in two ways:—as a chemical compound with hæmoglobin and in solution; increasing the bulk of blood may increase its oxygen-carrying capacity as a whole, although diminishing it relatively; hence the advantage of supplying more oxygen.

Dr. Reid Hunt, of the Johns Hopkins University, has kindly told me of some experiments which he has made in the Biological Department on the effect of intravenous injections of saline solution into dogs. He finds that in curarized dogs in which artificial respiration is maintained, the injection of normal saline solution, or of Ringer's solution, will cause a marked increase in the amplitude of the respiratory undulations of the blood pressure. This change often occurs before there is any rise of blood pressure or appreciable change in the pulse rate. He thinks it is due to a larger volume of blood passing through the pulmonary vessels. The accompanying kymograph curves are taken from one of his experiments. A is a portion of the record before; B, after the injection of 700 cc. of warm Ringer's solution into the saphenous vein of a curarized dog.

In this, we would have then an experimental proof of my clinical observation, viz., that infusion of salt solution increases the circulation in the lungs, and therefore their ability to take up more oxygen. The oxygen capacity being increased as a whole by increasing the bulk of blood, gives us an additional factor.



## A NOTE ON THE PIGMENT PRODUCTION OF *BACILLUS PYOCYANEUS* AND *BACILLUS FLUORESCENS LIQUEFACIENS*.

BY PAUL GERHARDT WOOLLEY, B. S.

(From the Pathological Laboratory of the Johns Hopkins University and Hospital.)

Some time ago while studying cultures of *B. pyocyaneus* and *B. fluorescens liquefaciens*, the similarity of the pigments produced by these two organisms seemed to me to indicate a possibility of interchangeability of chromogenic function. In these two particular cases the chromogenic peculiarities on agar-agar of the *B. pyocyaneus* seemed to be more nearly like those of *B. fluorescens*, while chloroform solutions of the pigment from agar-agar cultures of *B. fluorescens* showed a faint trace of blue.

Babes, Fordos, Gessard and Kuntz showed long ago that *B. pyocyaneus* produced three pigments, one fluorescent, not soluble in chloroform, one blue, soluble in chloroform, and the other a red, pyoxanthin, supposed by Gessard to be an oxide of pyocyanin or the blue pigment.

Since these observations Gessard, Wasserzug and others have shown how easily achromatic and monochromatic varieties or "races" could be produced artificially.

What I intended to do was to place *B. fluorescens lique-*



faciens, which is the fluorescent bacillus most nearly akin to *B. pyocyaneus* in cultural and microscopic characteristics, under conditions most favorable for production of pyocyanin and see whether or not a "race" could be obtained which would produce pyocyanin. For this purpose I used the medium known as *Gessard's Agar*, which is a neutral mixture of agar-agar, peptone and glycerine, and which Gessard found to be the best medium for forcing *B. pyocyaneus* to a maximum production of its blue pigment with a minimum of the other two pigments. In these experiments I used samples of *B. pyocyaneus* obtained from six different sources, and samples of *B. fluorescens* from five sources. These were grown at room and blood temperature. Each culture made was allowed to grow for three days and then cultures were made on fresh media from the cultures already grown. In this way an uninter-

rupted series of cultures was made from each specimen of the organisms, and extending over twelve transplantations.

The result however was negative. For one or two generations two of the fluorescent varieties did give some blue pigment soluble in chloroform, but at the end of the series all of the cultures of *B. fluorescens* were colorless, and only one of the cultures of *B. pyocyaneus* was typical. That one was a specimen for which I thank Dr. Jordan, of the University of Chicago. Evidently the color-line is not to be crossed.

Besides these results, I was able to confirm the statements made by Gessard, Noeske and others that the absence of phosphoric acid in some form inhibits the production of fluorescence. I also am able to state that the magnesium in Ushinsky's fluid can be replaced by aluminum with no effect upon pigment production.

## EXPERIMENTS MADE TO DETERMINE THE EFFECTS OF SUGAR UPON THE PIGMENT FORMATION OF SOME OF THE CHROMOGENIC BACTERIA.

BY PAUL GERHARDT WOOLLEY, B. S.

(From the Pathological Laboratory of The Johns Hopkins University and Hospital.)

Uniformity in the composition of culture media is one of the requisites of uniformity of observation in the study of bacteria in cultures. This is evident on its face; and yet it is probable that in the study of the bacteria in laboratory media the fact that a certain amount of sugar is present is not sufficiently considered, in spite of the fact that, in some conditions, for instance in the production of toxins by the *B. diphtheriae*, the presence of sugar makes a great deal of difference. Of course the quantity of sugar in the ordinary bouillon media is very small, but it is large enough to allow *B. coli communis* some exercise of its fermenting functions, and is therefore appreciable, and may also make appreciable differences in results in observations. It was in view of such facts as these that I set out at Dr. Flexner's suggestion to make a series of experiments with sugar-free and sugar-containing media to see what the effects of sugar upon certain functions of certain bacteria might be.

For these experiments the chromogenic bacteria seemed to be best suited, one reason being that many of them are known to be prevented from producing their pigment in the presence of sugar, and this, if true, would make it easy to determine with greater or less certainty the relation between the chromogenic powers of the organisms and the sugar present in the medium.

As examples of the chromogens, I selected *B. pyocyaneus*, *B. fluorescens liquefaciens*, *B. janthinus* and *B. prodigiosus*. As examples of the sugars I used glucose, lactose and saccharose.

In order to have a sugar-free medium as a means of making "check" observations, I treated bouillon made from fresh beef, by the method of Theobald Smith, the essential of which is the destruction of the sugar, present in such an extract, by the help of *B. coli communis*. To this bouillon when rendered

neutral and prepared in the usual way were added definite quantities of the three sugars. For the purposes of the experiments I used a 1 per cent. and a 2 per cent. solution of each of the three sugars. In all the experiments cultures were made in the sugar-free medium as "checks" upon the sugar-containing cultures.

In the first series of cultures, which were merely preliminary, the organisms were allowed to grow at a temperature of 37° C. until a maximum of pigment was developed. This time varied from seven to fourteen days. At the end of this time the cultures were sterilized and tested for sugar at leisure. Speaking generally, the results were that the pigment developed sooner in sugar-free bouillon and appeared earlier in the 1 per cent. sugar media than in the 2 per cent. media. The growth in itself was more rapid and luxuriant in the sugar-containing media, and at the end of the period of growth no sugar could be appreciated by Fehling's solution in glucose and lactose cultures, but some reduction did take place after inversion in saccharose cultures.

In the second set of cultures the same materials and the same organisms were used, but a temperature of 25° C. was adopted as a temperature best suited to *B. pyocyaneus* and *B. prodigiosus* at the same time. The cultures were allowed to grow not longer than seventy-two hours. One set was sterilized at the end of twenty-four hours, one at the end of forty-eight hours and one at the end of seventy-two hours. The results were as follows:

(In the following tables an  $\times$  represents the smallest amount of color in growth present in the three cultures on the same line. A zero means total absence of color. An "S" in a subdivision of a column means that in testing with Fehling solution after sterilization, sugar was present. A zero in a like place means absence of sugar.)

## CULTURES STERILIZED AT THE END OF 24 HOURS.

Organism.	Plain.	Glucose, 1%.	Glucose, 2%.
<i>B. pyocyaneus</i> {	Pigment.	× ×	×
	Reaction.	alk.	acid
	Growth.	×	×
<i>B. prodigiosus</i> {	Pigment.	0	0
	Reaction.	alk.	acid
	Growth.	×	×
<i>B. janthinus</i> {	Pigment.	0	0
	Reaction.	alk.	acid
	Growth.	×	×
<i>B. fluorescens</i> {	Pigment.	0	0
	Reaction.	alk.	acid
	Growth.	×	×

## CULTURES STERILIZED AT THE END OF 48 HOURS.

Organism.	Plain.	Glucose, 1%.	Glucose, 2%.
<i>B. pyocyaneus</i> {	Pigment.	× ×	×
	Reaction.	alk.	alk.
	Growth.	×	×
<i>B. prodigiosus</i> {	Pigment.	0	0
	Reaction.	alk.	ac.
	Growth.	×	×
<i>B. janthinus</i> {	Pigment.	0	0
	Reaction.	alk.	ac.
	Growth.	×	×
<i>B. fluorescens</i> {	Pigment.	0	0
	Reaction.	alk.	alk.
	Growth.	×	×

## CULTURES STERILIZED AT THE END OF 72 HOURS.

Organism.	Plain.	Glucose, 1%.	Glucose, 2%.
<i>B. pyocyaneus</i> {	Pigment.	× ×	×
	Reaction.	alk.	alk.
	Growth.	×	×
<i>B. prodigiosus</i> {	Pigment.	× ×	×
	Reaction.	alk.	alk.
	Growth.	×	×
<i>B. janthinus</i> {	Pigment.	×	×
	Reaction.	alk.	alk.
	Growth.	×	×
<i>B. fluorescens</i> {	Pigment.	× ×	×
	Reaction.	alk.	alk.
	Growth.	×	×

(In these tables it will be noticed that glucose media alone were noted because it was impossible to make differential tests for the various products of decomposition of the complex sugars in the presence of each other, and so to give reliable results.)

From the above tables the following conclusions can be drawn: 1. That pigment is produced more readily in sugar-free media. 2. That growth is more luxuriant in sugar-containing media. 3. That pigment is produced earlier in 1 per cent. glucose media than in 2 per cent. media.

Cultures in media containing lactose and saccharose as well as those containing glucose give evidence that glucose offers the best nutritive advantages, that lactose is less readily used, and that saccharose is only with difficulty made use of by all of the bacilli with the exception of *B. prodigiosus* which seems to thrive equally well in all.

## CHRONIC MALARIAL NEPHRITIS, WITH REPORT OF A CASE.

BY CHARLES W. LARNED, M. D.

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The two points of greatest interest in the case I have to report are, (1) the fact that the infection was of the quartan type, the rarest of the three recognized forms of malarial fever, having been noted in but about 8 per cent. of cases recorded in this institution, and (2) the associated nephritis which was almost certainly dependent upon this or a previous malarial infection. The only other possible predisposing cause was to be sought in an attack of measles during April, 1898. This however can be ruled out, since the attending physician states that the attack was light, and that there were no symptoms whatever suggesting involvement of the kidneys, and especially when we take into consideration the infrequency of measles compared with malarial fever in this locality as an etiological factor in nephritis.

As to the connection between measles and a consequent nephritis, the following citations are of interest: Tirard<sup>1</sup> says, "It is comparatively rare for albuminuria to be associated with measles, and there is reason for suspecting that some of the cases which have been described under this heading were

really cases of scarlatinal nephritis." Blum<sup>2</sup> in a collection of 45 cases of measles records but one that showed any renal involvement. Carr<sup>3</sup> collected at the Infants' and Children's Hospital, Randall's Island, 107 cases of measles, only one of which showed a nephritis, the condition being associated also with broncho-pneumonia with purulent infiltration, emphysema and pleurisy. Albutt<sup>4</sup> in London, where malarial fever is so uncommon, has collected 136 cases of nephritis due to all causes; of these, he attributes 3 to measles and one to malarial fever and exposure. Smith,<sup>5</sup> Goodhart,<sup>6</sup> Ashby and Wright,<sup>7</sup> Tyson,<sup>8</sup> Osler,<sup>9</sup> Anders,<sup>10</sup> and others, conclude that nephritis, if it ever occurs as a complication of measles, is exceedingly rare in this connection. Holt<sup>11</sup> has never seen a severe degree of nephritis associated with measles either clinically or at autopsy.

On the other hand malarial fever as an important factor in the production of nephritis has been recognized for a long time. The statistics at the Johns Hopkins Hospital, compiled by Thayer, and published in a recent monograph "On Nephritis of Malarial Origin," show that in 758 cases of malarial fever

treated in the wards, there were 21 instances of acute nephritis; of this number 11 recovered, 4 died, and in 6 the result was unknown. In four instances Thayer believes the process may have assumed a chronic form. He also states (page 23) that, "Out of 112 instances of acute nephritis observed in the Johns Hopkins Hospital, 21, or 18.7 per cent., were of malarial origin." He does not mention measles as a predisposing cause, although he gives statistics of cases of nephritis resulting from diphtheria, typhoid fever and scarlet fever.

Charcot<sup>12</sup> says that the albuminuria coincident with intermittent fever is at times transitory, augmented during the paroxysm, diminishing or disappearing entirely during the intermission, and ceases to exist the moment the fever is cured, or a short time after recovery . . . . but that at other times the albuminuria persists a long time after the cessation of the paroxysms and takes on decidedly the chronic form.

Hertz<sup>13</sup> in speaking of albuminuria during malarial fever says "More frequently albumin is to be found after long-continued attacks of intermittent fever, or while a person is laboring under the malarial cachexia, and is then constant and quite abundant, depending upon the existence of an enlarged kidney or an amyloid degeneration of the renal vessels."

Rosenstein states that the dropsy and ascites accompanying nephritis of malarial origin attain a higher grade than in nephritis from any other cause.

Bartels<sup>14</sup> claims that next to chronic suppuration "Marsh Miasm" is the most frequent cause of chronic parenchymatous nephritis. He also thinks it may produce this condition without having been attended necessarily by paroxysms of any degree of intensity.

Tirard<sup>15</sup> holds rather uncertain views on this subject, stating that the influence of malaria as an etiological factor in chronic nephritis is open to considerable doubt. Further on he says "It must be admitted also that observations made in Algiers and Bombay show that in these places the association of chronic Bright's disease with malaria is as marked as it is in colder climates; hence the supposition that malarial nephritis is essentially due to exposure to cold scarcely seems to be tenable."

The pathological changes occurring in the kidneys during this disease have been studied by Bignami,<sup>16</sup> Barker,<sup>17</sup> Bastianelli,<sup>18</sup> Laveran,<sup>19</sup> Kelsch and Kiener,<sup>20</sup> Rem Picci<sup>21</sup> and others.

Kiener<sup>20</sup> in 1877, seems to have been the first to have worked up the histology with any degree of method; later in 1881 and 1889,<sup>22</sup> in conjunction with Kelsch, the same author did excellent work in this field. In their former work (pp. 279 and 495) they do not identify any particular form of chronic nephritis as the result of the malarial poison, the tissues reacting in the same way as to any other morbid impression, the process not confining itself to either the connective tissue or the secreting portions of the gland, the picture presented being that of a diffuse nephritis. At first the glomeruli and epithelium suffer most, the connective tissue being affected later. This however they do not claim as a fixed rule.

In their later work (page 276) besides going extensively into the pathological anatomy both microscopically and macroscopically they give at length the clinical aspects of the disease. Their conclusions are to the effect that this form of

nephritis may be insidious during the course of a chronic malaria and discovered unexpectedly at the autopsy. At other times eclampsia finally reveals very suddenly a lesion already far advanced. In certain cases the symptoms are those attributable to an acute parenchymatous nephritis with anasarca, sudden, considerable and of rapid development, with scanty high-colored and bloody urine. In other cases the urine is clear, slightly albuminous, containing a few hyaline casts.

The consensus of opinion expressed by the different observers of the acute form seems to be that the pathological changes are not great, there being some pigmentation of the glomeruli with albuminous exudates and casts, the epithelium of the convoluted tubules being more or less swollen and degenerated.

Charcot<sup>23</sup> thought that the pigmentary alteration of the cortical substance might possibly be regarded among the organic causes of the persistent albuminuria.

The history of my case is as follows:

M. B., female. Age 7 years 5 mos. Colored. Complains of swelling of the abdomen.

*Family History.*—Negative.

*Past History.*—Child has never been strong, but has escaped the diseases incident to childhood, with the exception of measles, which she had during April, 1898.

In July or August of 1895, '96 and '97, the child visited Prince George's county, Maryland, and upon each occasion contracted chills and fever; the attacks were cut short and apparently cured by the administration of quinine, the paroxysms occurring each day, the chill and fever being quite marked.

The *present illness* dates back to July, 1898, when patient visited Anne Arundel county, Maryland. She commenced feeling badly while there, but did not have marked malarial paroxysms, only an occasional fever and sweat. On her return to Baltimore, at the end of two weeks, the grandmother noticed that the child's face was much fuller than when she left; in fact she thought the child was looking remarkably well. She attached no significance to the swelling till the abdomen commenced to enlarge; she then took her to one of the hospital dispensaries where a careful abdominal examination was made, but neither the urine nor the blood was examined. She was prescribed for, but the condition gradually grew worse, the abdomen becoming so distended that the patient could no longer be carried to and from the hospital. It was at this time, September 24th, that I first saw the child. I found her intensely weak; she could not turn in bed without assistance; there was no headache; appetite fair; no nose bleed, no herpes; slight cough; no pain in back or limbs; bowels loose since taking medicine prescribed at dispensary.

Physical examination showed marked oedema of the face, genitalia and ankles. Abdomen very much distended, tense, and exhibiting the usual signs of ascites; teeth irregular and notched but no pegging; tibial rickets; the heart's action was rapid, 128 per minute, forcible, apex not displaced, no murmurs; slight accentuation of aortic and pulmonic second. Lungs gave crackling râles over both bases with marked purile breathing everywhere; respiration 46 per minute, thoracic in character, temperature 99° F.

The same evening I did a paracentesis abdominis, removing three quarts of turbid fluid, after which abdominal palpation



showed plainly the edge of the spleen about 5 cm. below the costal margin; the liver was not palpable. Suspecting malarial fever, treatment was deferred until the following morning when an examination of the fresh blood was made. This showed one or more intracellular parasites to nearly every field, the infected cells being decidedly smaller than normal, the organism occupying nearly the whole if not the entire corpuscle, the part remaining being greenish and easily discernible. The parasites were quite refractile, the pigment coarse, the granules not numerous, without motion, collected at the periphery and in many instances at the centre. There were many typical segmenting organisms seen, the number of segments ranging from seven to twelve; also one oval form. There were no hyaline forms noted.

This examination was made about 10 A. M., and when the child was seen, about 5 P. M., her temperature was 104.2°. I was prevented from making any further blood examination for three days, quinine being given in 4-grain doses during the interim. The parasites had then disappeared from the cutaneous circulation with the exception of an occasional atypical contracted form, pigmented leucocytes being quite numerous; a leucocyte in process of surrounding a small extracellular pigmented organism was noted.

The urine was light amber, slightly cloudy, acid, sp. gr. 1010. On boiling, almost a solid precipitate was thrown down; Esbach's albuminometer showed 2.1 per cent. albumin.

Microscopically there were hyaline, fine and coarsely granular, also epithelial casts, a great deal of detritus, no red cells, a few leucocytes and epithelial cells.

Fleischl's hæmoglobinometer showed 35 per cent. hæmoglobin.

Upon questioning members of the family further, a history of fever on every fourth day was easily obtained. The absence of chills and the fact that the child had been feverish only occasionally had not led them to suspect a malarial infection.

The treatment instituted was essentially, quinine, Bland's pills, and later, Basham's mixture or bitartrate of potash; restricted diet and rather free purging. The child's condition improved steadily, the oedema rapidly disappearing; the hæmoglobin when last taken, October 15th, was 65 per cent. The amount of albumin, however, was always high, never going below  $\frac{1}{10}$  per cent.; the specific gravity remaining in the neighborhood of 1010. The total amount of urine in 24 hours could not be estimated owing to constant action of bowels.

From October 15th to March 5th, 1899, I saw nothing of patient. On the latter date I was summoned at 10 A. M. and found the child profoundly comatose, pulse 160; she had had several convulsions during the previous five hours; her condition up till the day before had been considered good by the parents. Morphine, chloral, bromide and chloroform were administered with but little effect upon the convulsions, death occurring at 2.30 P. M. An examination of the blood just previously failed to show parasites.

*Autopsy.*—A partial autopsy only was granted, a member of the family remaining in the room. Notes taken just after are as follows:

3.30 P. M. Rigor mortis quite marked. Poorly nourished. Small for age. Rickety. Slight oedema of face and ankles. Abdomen distended, apparently by gas.

Abdominal incision showed marked agglutination of intestines, so much so that in getting back to the kidneys the gut was torn in several places. Edge of liver was not below costal margin; spleen extended about 2 cm. below costal margin; surface rather granular.

*Kidneys* slightly larger than normal, soft, capsule not adherent, surface rather granular, of a pinkish grey color, studded here and there with dots suggestive of fat. On section these same yellowish dots are noted. Cortex somewhat translucent. Striation not at all well marked. Glomeruli indistinct.

Dr. MacCallum who hardened and prepared the sections gives the following report:

Microscopically the kidney presents the picture of a chronic diffuse nephritis of the interstitial type. The glomeruli are extensively obliterated by an ingrowth of connective tissue along the vessels or by a thickening of the capsule. In the section a few are relatively normal, and in nearly all the capsular epithelium is fairly well preserved.

The connective tissue growth is quite diffuse, and the urinary tubules are generally compressed and atrophied. The well-known appearance of dilatation of the tubules in certain areas with flattening of their lining epithelium is present. Such dilated tubules contain masses of granular, colloid or hyaline material mixed with a few leucocytes and desquamated epithelial cells.

The tubules in general show flattening of the epithelium and evidences of degeneration in the epithelial cells. Many are desquamated into the tubules which in places contain a considerable number of polymorphonuclear leucocytes. Fatty degeneration of the cells is not, however, so extensive as one might expect. There seems to be a good deal of fat in the interstitial connective-tissue cells.

The blood-vessels show an extensive endarteritis.

#### CONCLUSIONS.

The conclusions to be drawn from this and other cases already on record, especially Thayer's and those of Kelsch and Kiener, are:

1st. Certainly in some localities malarial fever should be given a prominent position in the etiology of chronic as well as of acute nephritis.

2d. In all cases of malarial fever the urine should be closely watched.

3d. A blood examination should be made in all cases of nephritis occurring in those who have visited or lived in a malarial district, as it often happens that the severe grade of nephritis resulting may mask entirely the clinical picture of malarial fever.

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## A CASE IN WHICH THE BACILLUS AEROGENES CAPSULATUS WAS REPEATEDLY ISOLATED FROM THE CIRCULATION DURING LIFE.

By N. B. GWYN, M.B., *Assistant Resident Physician, The Johns Hopkins Hospital.*

The generalized distribution of the bacillus aerogenes capsulatus throughout the body, as seen at autopsy, is usually ascribed to a pre-agonal dissemination from a local lesion or other source, and the recognition of the condition has so far been post mortem; the case of Graham, Stewart and Baldwin shows that the organism invading the general circulation may produce characteristic lesions in the tissues several hours before death; in this instance there had occurred an abortion and subsequent infection of the uterus, from which point the general infection proceeded. It is possible that in the living tissues of a subject presenting no local lesion, and whose resistance to infection has not been completely lost, the gas-producing and other functions of an organism may be more or less inhibited and the nature of the infection not become evident. The following case was probably influenced by these conditions, for although the *B. aerogenes capsulatus* was repeatedly demonstrated during life, none of the characteristic evidences of its presence as seen post mortem were to be made out.

The case, diagnosed as chorea insaniens, gave this history:

Alice B., white, aged 18, school-girl. Admitted May 13, 1899, complaining of St. Vitus's dance; family history, negative; had most of childhood's illnesses, and when 9 years old had mild chorea, from which she completely recovered without subsequent heart or joint symptoms.

Two weeks before admission she had been suffering from insomnia, extreme restlessness and nervousness; a few days later she was said to have been in a condition of severe nervous prostration and was sent home from school. On the way home she suffered from delusions of persecutions, imagining that the passengers would injure her. She showed great incoordination in her gait, reeling from side to side, tossing head and arms about and contorting her face. Her speech was slow, but intelligible. She grew rapidly worse, and by May 12 apparently every voluntary muscle of the trunk, face and limbs was affected, she being unable to talk or to feed herself. On admission she was unable to walk, was unintelligible in talk and quite out of her mind. There were ceaseless involuntary purposeless movements of muscles of face, limbs and trunk, the patient tossing and throwing arms and legs about, muttering and gibbering. There were no joint symptoms; no com-

plaint of pain anywhere; no subcutaneous fibroid nodules; some erythema of elbows and knees from constant friction. Her pulse was regular, rapid, from 100-120. At apex of heart a slight thrill with systole was to be felt. On auscultation merely a booming, first sound, an accentuated pulmonic second sound and a soft systolic murmur over the pulmonary area were heard. There was no pericardial friction.

Her respiration was irregular, partly owing to irregular contractions of abdominal wall; lungs clear; knee-jerks exaggerated; no ankle clonus; plantar reflex present.

Patient improved for first few days after entry; facial movements became decidedly less and her mental condition clearer; the movements of trunk and limbs persisted. During this time her daily temperature had been ranging from 99° to 100° F., the nightly record being often higher, but in order not to interrupt the effects of sedatives was not regularly recorded. Stools and urine were voided involuntarily; in the latter a trace of albumen and a few casts were to be found.

After a few days of apparent improvement her symptoms became exaggerated; the temperature rose to 101.5°-101.7° on May 25 and 27; her pulse became more rapid and weaker. By May 28 her temperature was ranging between 103°-104° F. Her mouth and tongue were dry and fissured, the movements much more marked. Patient began to show signs of extreme exhaustion from ceaseless rolling and tossing. On June 3 she passed into a semi-comatose condition, remaining so till death, on June 6, on which date her temperature reached 106.5°.

A few hours before her death, a large, painful swelling of the right parotid was observed. There was no redness of the overlying skin, no fluctuation and no emphysema. No subcutaneous emphysema was to be felt over the body before or at death; after eight hours in ice-chest there were no alterations to be observed. Unfortunately, no autopsy was obtained.

The rapidly fatal course of this case and the concurrent symptoms suggested at once the presence of an infective agent, and cultures were repeatedly taken to determine its presence; the long-considered connection between rheumatism and chorea induced us to make use of the methods employed in the demonstration of the bacillus of Achalmé, described recently by Achalmé, Thiroloix and Savchenko in cases of rheumatic fever.

On May 16, 22, 24 and 27, and June 6 cultures were taken



from a vein of the fold of the elbow, 30-50 cc. of blood being extracted and distributed in different media.

*Cultures of May 16.* Aerobic cultures in bouillon and on agar plates and anaerobic in milk and bouillon mixture remained sterile. The cultures of May 22, 24 and 27 were made anaerobically in mixtures of milk and bouillon as recommended by the above observers, tubes of the same lot of media, and cultures from other patients in the same media being employed as controls; to further guard against error, an examination of the fresh blood for organisms was systematically pursued, and on two occasions several distinct bacilli resembling, morphologically, the bacillus to be described could be demonstrated.

All control tubes remained persistently sterile. Pure cultures of a large, non-motile bacillus were obtained from the patient on May 22 and 24, but a failure in obtaining anaerobic condition in the Buchner jar probably interfered with the development of bacilli on May 27. Although the sterility of the control tubes, the presence on two occasions of the same organism and its demonstration in the fresh blood were quite convincing, it may be objected that cultures in fluid media give chances of accidental contamination, and further that no idea of the number of organisms present is obtained. On these grounds, subsequent cultures on June 6 were controlled by the plate method.

As a rule, 5-10 cc. of blood were placed in each tube or plate. After 12-18 hours in Buchner jar at 37°, the inoculated tubes of milk and bouillon showed evidences of a very vigorous bacterial development: on the surface, a pinkish, fissured, firm, retracted clot: clinging to the sides of the tube clots also fissured, and containing gas bubbles, which, rising continually to the surface, formed there a frothy layer. The fluid in the tube had assumed a port-wine color, becoming black on exposure to air. The clot of blood was completely disintegrated, and an aromatic cheesy odor could be detected.

On glucose agar plates after 12-18 hours, 12 small, irregular colonies were visible, which after 48 hours were 1-2 mm. in diameter, gray-brown, with irregular margins, occasionally showing a central dot. An occasional gas bubble was to be seen about some. Numerous colonies of streptococci were also present at the last culture inoculation.

Microscopically, both in fluid and solid media the growth was found to be a large non-motile bacillus 8-10  $\mu$  in length, about 2  $\mu$  in width, very regular in size, with rounded ends, occurring singly or joined in pairs, often at an obtuse angle; rarely were more than 3-4 organisms seen in chains: an appearance as of a capsule was to be seen, which was subsequently demonstrated in experiments. The bacillus stained well by Gram; aerobic growth on the ordinary media did not occur, development taking place only anaerobically or in hydrogen. On agar slants small separate and fused gray-white colonies with somewhat irregular dentate margins were to be seen, an occasional gas bubble developing at bottom of tube.

Glucose agar was regularly broken up, and segments of the media were forced up the tube by the pressure of gas, some fluid appearing on top and in the spaces formed below.

In litmus milk and bouillon, gas formation was shown by the presence of numerous frothy bubbles on surface; in the former, in 18-24 hours, were to be seen fissured and retracted

clots in a whey-like fluid, the clots, at first white from decolorization by hydrogen, becoming pink on exposure to air, thus indicating an acid reaction. The bouillon showed general cloudiness with a stringy, yellowish precipitate. Potato gave a scarcely visible film, often with gas formation in fluid below. Gelatin allowed a slow growth with production of gas bubbles and a general softening of the media; no complete liquefaction.

On blood serum (Loeffler) small isolated growths or a film of fused colonies, gray-white in color, developed. An odor of stale glue was noticeable, especially from the growth on solid media. A most abundant growth was always to be obtained in mixtures of milk, bouillon and serous fluid or blood. Under these conditions it could be repeatedly shown that development in presence of oxygen was possible. A standard culture of bacillus aerogenes capsulatus lent me by Dr. Harris responded to the same test. Further aerobic development in transplants on other media from these tubes has so far not been obtained.

Greater regularity of size of the organisms was observed in the young cultures on agar and blood serum; in fluid media short forms and chains appeared, the latter after several days' growth extending over several fields of the microscope; interesting involution forms were often to be seen on surface growths, irregularly staining, dentated, swollen or club-shaped bacilli.

Spores, usually centrally situated, oval,  $\frac{1}{2}$ - $\frac{3}{4}$  length of containing bacillus, were found on blood serum inoculated from a several days' old milk-tube; occasional end spores were also demonstrated; little swelling of the body of the bacillus was caused by their presence.

Continued transplantation of the organism tended to diminish slightly its size and regularity, smaller diplo-bacillus forms appearing in large numbers; occasionally in media to which blood or serous fluid had been added distinct capsules were to be demonstrated. Experimental inoculations proved that rabbits were insusceptible to intravenous injections of as much as 5-10 cc. of actively-growing culture. Killing the animal 3-5 minutes after the injection and keeping the body at room temperature showed enormous gas development in 4-8 hours. The subcutaneous emphysema, the condition of the liver and other organs, the presence of gas in the heart and vessels, serous cavities and tissues as described by Welch, Nuttall, and Flexner being accurately reproduced.

A slight detonation accompanied the ignition of the gas, which burnt with pale blue flame. Organisms in abundance showing distinct capsules could be obtained in pure cultures from the blood and tissues.

Guinea-pigs were killed in from 36-48 hours after subcutaneous injection. At site of inoculation characteristic lesions were produced, extensive oedematous infiltration of tissues with exudation of bloody serous fluid; in one animal the pericardium was found filled with fluid, evidently an extension of the oedematous process. Numerous bacilli, fibrin flakes and cellular elements containing organisms were present in the exudate; in most inoculations slight gas formation evidenced by emphysematous crackling was noted; in others it was perhaps too slight to be observed; necrosis and rupture of overlying skin were frequently seen.



In pigeons death ensued in shorter time, 24-36 hours. At site of inoculation some slight emphysema could be felt, which, however, might have been post mortem; œdema and sero-sanguinolent exudation with brownish-red discoloration and softening of the muscles were produced. Bacilli in numbers were present in the lesions. Depending upon the time elapsing before autopsy, greater or less numbers of bacilli could be detected in the blood and organs of the guinea-pigs and pigeons.

This resumé of cultural and experimental reactions seems sufficient to show that the organism is identical with the bacillus aerogenes capsulatus of Welch and Nuttall. The cultures obtained on three occasions corresponded accurately, and illustrate the possibility of a long continued infection by this organism, the first positive result being 13 days before death.

The gas-forming property of the bacillus, when in the circulation, may apparently remain in abeyance during the life

of the infected individual; the duration of the infection, the seeming abundance of the infecting agent as evidenced by their demonstration in the fresh blood, and the fact that a general streptococcus invasion helped to produce the fatal ending, indicate but a limited degree of virulence on the part of the organism.

It is not assumed that the infection with the bacillus aerogenes capsulatus bears any etiological relation to chorea insaniens, the affection diagnosed in this case, but the bacterial association is of interest in connection with the acute infectious character this disease often presents.

According to Dr. Welch, to whom I am indebted for valuable suggestions, this is the only instance in which the bacillus aerogenes capsulatus has been demonstrated in the circulation during life; whether present as a primary or secondary infective agent is yet to be decided.

## PROCEEDINGS OF SOCIETIES.

### THE JOHNS HOPKINS HOSPITAL MEDICAL SOCIETY.

*Monday, March 6, 1899.*

#### Remarks upon a Case of Jejunal Fistula.—DR. CUSHING.

Surgical No. 8025. The patient, Lawrence L., from North Carolina, aged 28, entered Dr. Halsted's service on the 17th of August, 1898, with the history of having received ten years previously a razor cut across the abdomen which had completely severed the intestine in one place and had opened it in two others.

As a result of this injury from which he had made a marvelous recovery, an intestinal fistula, which was practically complete and which had resisted a subsequent operative attempt at closure, had persisted in the abdominal wall. On several occasions he had nearly starved to death from periods of inability to assimilate sufficient nourishment from the ingesta before it was lost through this accidental enterostomy wound.

His appearance on admission was most extraordinary. He was a man of large frame, emaciated to a degree and weighing only 93 pounds. His abdomen and thighs were covered with an acute brilliant dermatitis, which extended from the costal margins almost to his knees resultant to the irritating, continuous discharge from the fistula, which was situated in the median line below the umbilicus. To the right of this in the scar which extended almost across the whole abdomen there protruded a large ventral hernia (cf. photograph) through a transverse separation of the parietes about six centimetres in width.

The coils of intestine in this hernia showed a more or less constant visible peristalsis, and from the fistula, through which a rosette of mucous membrane usually protruded, issued in jets an acid, irritating and frequently bile-stained fluid. The skin everywhere in the vicinity was raw and thickened and so tender it could not be touched. The patient's mental condition, possibly as a result of his chronic starvation, was unbalanced and he had several epileptiform convulsions during his first days in the hospital, and the history mentions the occurrence of similar attacks during the past few years.

He was put in a continuous bath and was fed with nutrient enemata. Attempts to feed through the fistula were unsuccessful. The condition of the skin under water cleared up rapidly and he began to gain in weight under the rectal feeding.

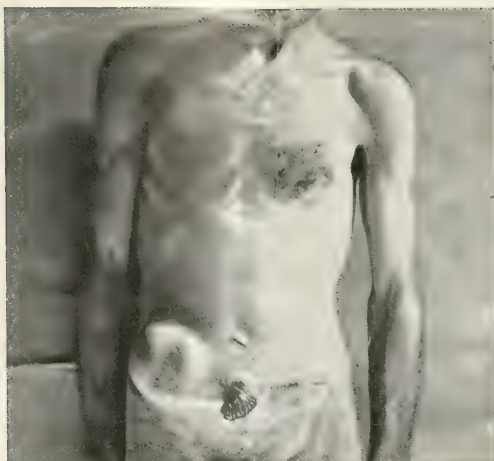
Some months later he was operated upon; the fistula was closed by a resection of the bowel and end-to-end suture over a Halsted inflated rubber cylinder. The adherent coils of intestine were freed from the hernia sac with difficulty, necessitating another partial resection at one place. The abdominal wall was closed without drainage after excision of that part of the parietes involved in the hernia.

His convalescence was uninterrupted. His weight, 180 pounds to-day, has almost doubled itself since the operation. He gained eleven pounds in one week shortly after the operation.

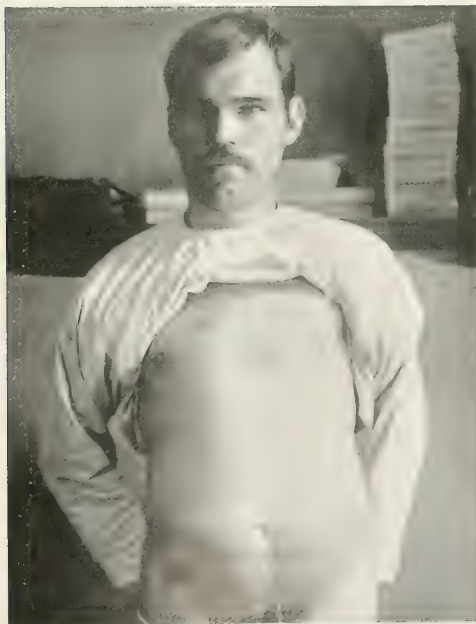
The case presented many opportunities for physiological study, some of the results of which will be briefly mentioned here.

The situation of the fistula was evidently high up in the alimentary canal as was evidenced by the irritation produced upon the skin by the discharges.

It has been a common observation that the degree of dermatitis surrounding an intestinal fistula becomes more pronounced as the situation of the opening approaches the duodenum. The usual colostomy made in the large bowel causes no cutaneous irritation. It seems not unlikely that the pancreatic juice is chiefly responsible for this condition, as no fistulæ are so intensely irritating to the skin as those produced by opening and draining pancreatic cysts which have retained some communication with the secreting gland. In two other cases of high fistula now present in the wards, it has been necessary to place the patients in a continuous bath to control this acute eroding dermatitis. One was the result of a temporary fistula at the site of suture following a pylorectomy for carcinoma; the other was resultant to the establishment of a jejunostomy for post-operative obstruction. Biliary fistulæ are unirritating. Gastric fistulæ are commonly not followed by cutaneous inflammation.



December, 1898, weight 93 lbs.



February, 1899, weight 178½ lbs.

*Surgeon No. 8025. Case of Fistula and Ventral Hernia.*





A method of determining the *exact distance of the fistula from the stomach* was suggested by the accidental discovery that oysters were discharged from the opening a short time after ingestion, practically unchanged. A piece of ligature silk was sewed through one of these before it was swallowed and three hours later the oyster appeared at the fistula. On careful measurement it was found that 3 feet 11 inches of string reached from the patient's teeth to the fistula. Peristaltic action was so strong and tugged at the string so vigorously after the oyster had been expelled that the patient had tied the buccal end of it about a lead pencil, which he was wearing between his teeth like a bit to prevent the string's disappearance. This measurement showed the fistula to be high in the jejunum, possibly one foot below the duodenum.

*Physical examination* of the stomach showed that there was no dilatation despite the extraordinary amounts of food, solid and liquid, with which the patient was accustomed to gorge himself at frequent intervals. Naturally a condition of chronic gastritis was present and the stomach contents after test meals showed great variability on chemical examinations. The reaction was always acid, sometimes due to free HCl, sometimes when this was absent, to fatty acids. This lack of constancy in the analysis of the gastric secretions unfortunately led to some variability in the results of many of our observations.

The *propulsive power* of the stomach and intestine above the fistula was very great. A glass of milk given on an empty stomach on one occasion began to appear, acid in reaction and finely coagulated, at the fistula in one minute and had been entirely recovered in four minutes. This rapid emptying of the stomach seemed most extraordinary. The patient had learned to prevent this immediate loss of food by swallowing large un-masticated pieces of meat and vegetables so that he would occasionally succeed in obstructing the pylorus and apparently at times the fistula itself, thus allowing of some absorption by the bowel above or possibly of some passage by the fistula. When the stomach was empty, peristalsis of the proximal bowel, seen through the thin parietes covering the hernia, was especially active and associated with "gnawing cramps" and the mucous membrane would protrude from the fistula to such an extent that on one occasion it became nearly strangulated when food had been withheld for 12 hours. (Cf. Photograph I.)

This motive activity was further shown by the fact that cold beverages would appear at the fistula before they had been warmed to the body temperature. A glass of ice water would reduce the temperature at the fistula a full degree while it was being discharged, and at such times the coils of intestine adherent in the hernial sac felt perceptibly cold to the hand.

Attempts to determine the *absorptive power* of the stomach were unsatisfactory. The fistula was too tender to allow the wearing of any apparatus to collect the discharge. Under ordinary circumstances when the stomach was empty there seemed to be no diminution whatever in the fluids collected from the quantity taken into the stomach. Whether there was some absorption when the bowel or fistula was blocked with food could not be certified.

The *reaction* at the fistula despite its proximity to the pan-

creatic ducts was quite uniformly acid, increasing in degree during digestion. It was due largely to the presence of fatty acid.

Some observations of great interest were made with Dr. Clopton on the *bacteriology* of the contents of the bowel under various conditions. These will be published in full in a forthcoming paper on the flora of this part of the intestinal tract. The great variation of the gastric acidity, chiefly in HCl, unfortunately made these observations at times somewhat uncertain. During active digestion on a mixed diet the flora of the discharge showed great diversity of organisms. It was found that several varieties of pathogenic bacteria taken into the mouth in inoculated milk could be recovered readily and grown at the fistula. We also succeeded in demonstrating that the ingestion of a sterilized diet, the mouth meanwhile being rendered as clean as possible by frequent antiseptic washes, was followed by a pronounced diminution in the number of colonies on plates inoculated from the lumen of the proximal bowel. For forty-eight hours before the operation every precaution was taken to prevent the entrance of micro-organisms through the mouth, and, at the time of operation, cultures taken from that part of the bowel above the fistula, where a partial resection was rendered necessary, remained sterile, and no organisms could be demonstrated on stained preparations from the mucosa. Resection and "end-to-end" suture followed by closure of the parietes without drainage, under such circumstances, is attended with little risk.

I regard this as an all-important procedure, when time permits, in the preparation of a patient for a laparotomy during which the bowel is likely to be opened or when a resection and suture is premeditated. The results of observations in this direction during the past year will be published.

#### **Treatment of Acute Otitis Media following Influenza.—DR. THEOBALD.**

I wish, to-night, to speak more especially of the abortive treatment of these cases when one can see them in the earliest stage.

There have been, as you probably know, an exceptional number of serious ear troubles following the influenza or grippé. The statistics bearing upon this subject that Dr. Bacon gives in his recently published treatise upon the ear are interesting. He says that a few years ago 12 to 20 cases of mastoid disease were about the average met with in the course of a year in the New York Eye and Ear Infirmary, while in 1897 there were 161 mastoid operations. He attributes this great increase to the prevalence of influenza.

The most serious involvements are those in which the brain is affected. This may happen in several ways. Epidural abscess is one of the more common forms, and purulent meningitis is another. Abscess of the brain substance itself or thrombosis of the lateral or sigmoid sinus are other ways in which the brain may be involved.

The modes of infection of the middle ear may be referred to in passing. The most common way is through the Eustachian tube. Nature has provided a means for lessening the likelihood of this happening, the ciliated epithelium of the Eustachian tube acting in such a way as to hinder the entrance of bacteria

from the nasal cavity into the middle ear, but it is only partially successful. Another route of infection is through a perforation in the tympanic membrane. The infection may occur also through the blood-vessels or the lymphatics.

Various micro-organisms have been found in suppurative middle ear inflammations. The staphylococcus aureus and albus, the streptococcus pyogenes and the pneumococcus are among the most common, the two first-named being found especially in the milder cases. The micro-organism that is supposed to be the cause of influenza is occasionally found, but is usually accompanied by other organisms. My own experience is, that the purulent infection occurs very frequently, only after perforation of the tympanic membrane. This is not always so, for often when the tympanic membrane is incised pus escapes; but not infrequently the discharge is not purulent but sero-mucoid, tinged with blood, and does not until later become purulent. It is a very difficult matter, even with antiseptic precautions, to prevent infection after a perforation has occurred or an incision has been made through the tympanic membrane, for one cannot sterilize the skin of the external auditory canal as thoroughly as the skin upon other parts of the body may be sterilized.

Every one is familiar with the symptoms of inflammation of the middle ear. Pain is the most prominent symptom, and deafness occurs, but the pain is so great as to prevent attention being called to the latter. Tinnitus aurium is usually present. The temperature, in children especially, is apt to run high. Even in uncomplicated cases in children it may reach 105°. In adults we are not apt to have so high a temperature unless there are serious complications.

In the beginning of the attack, if we inspect the ear with the mirror and speculum, we will see a hyperemia of the upper part of the membrane, especially of Schrapnell's membrane, and running down the handle of the malleus will, perhaps, note a line of congested vessels. A little later, the whole membrane becomes red and loses its normal appearance. If the attack runs a little longer we shall usually find evidences of fluid in the tympanic cavity, causing bulging of the membrane, usually of the posterior and lower quadrant, but sometimes of the membrana flaccida.

What I want to speak of more particularly is the early treatment of these middle ear inflammations, especially of those cases following the gripe. I believe, in the large majority of instances, if we can see these cases early, that is, within a few hours of the onset of the pain, we can cut short the attack. I think it is greatly to be desired that this should be accomplished, for if the inflammation is not controlled promptly it is extremely difficult to prevent suppuration. Even when this occurs, most of these cases, it is true, do well; but we never know when serious complications may supervene.

I have recently met with the most rapid death following ear disease that I have ever encountered. The patient had had influenza, had been out and exposed to cold, and was taken on Friday with ear-ache. She suffered severe pain Friday night and Saturday and was given morphia liberally to relieve the pain. On Sunday she showed signs of nervousness and irritability, and when I saw her, for the first time, on Tuesday evening she was delirious, had a temperature of 105°, and

a very rapid pulse, and a look into the eyes satisfied me that there was commencing optic neuritis.

There was no reason to suppose, in this case, that the mastoid process was involved, but it was evident that there had been a direct extension to the brain from the tympanum, and there was no doubt of the existence of a meningitis. An extensive operation upon the brain suggested itself as a possible means of relief and, at my suggestion, Dr. Finney saw the case, but he thought the condition of the patient was such that no operation was advisable, and she died on the following morning. This is an extreme instance of how rapidly ear disease may induce fatal brain complications. If, then, we can abort these cases, in which such a result is a possibility, it is most important to make the attempt and make it early. The plan of treatment which I recommended years ago, and for which I have been given considerable credit, although I do not deserve it, as the suggestion was not original with me, is the using in the ear of a solution of atropia, to which I have added more recently cocaine. I prescribe either a watery solution of atropiæ sulphate and cocaine muriate, or a solution of the alkaloids of atropia and cocaine in oil of sweet almonds. In either case the strength of the solution is half a grain of atropia and one grain of cocaine to the drachm. The advantage of the oily solution is that it remains in contact with the tympanic membrane for a longer time and so favors freer absorption, and further, if there is a perforation of the membrane present it is not so likely to find its way through the Eustachian tube to the throat and produce constitutional effects. When the solution is to be put into the ear the patient should lie down with the affected ear up, and should be kept in this position for at least ten minutes, so that the solution may remain upon the tympanic membrane. A little cotton can then be put in the ear and the head raised.

Eight drops of the solution, warmed (5 or 6 drops in the case of children), are used at a time. This means about 1-15 grain of atropia; but the absorption is very imperfect and there is no danger of constitutional effects from the application, unless a perforation of the membrane exists. Where this is the case, however, one should be a little cautious, and I always speak of the possibility of constitutional effects, and advise accordingly. The instillations may be repeated 3 or 4 times a day as long as pain is present. I have seen occasionally slight evidences of the systemic action of atropia from this plan of treatment, but never anything alarming. In addition to this local treatment I give small doses of calomel every hour or half hour until the bowels are freely moved, and if the effect of the calomel in this respect is slight I prescribe a saline cathartic.

The result of this plan of treatment, if only one sees the case in its incipency, is usually extremely satisfactory. The pain is often relieved within a few hours and the inflammatory process controlled so effectually that in the majority of cases an incision of the membrane or a spontaneous perforation is avoided.

After the acute symptoms have subsided, the tinnitus and deafness which are apt to remain are benefited by liberal doses of muriate of ammonia—ten grains, three or four times a day. If the pain is not controlled by the cocaine and atropia instil-



lations, antikamnia or phenacetine may be administered, or, if necessary, morphia. It is not safe, of course, to wait indefinitely for the effects of this treatment; but my experience with it has been so favorable that I am sure I wait longer than many do before incising the tympanic membrane. If it is evident that the tympanum is distended with fluid a free incision should be made, preferably through the posterior portion of the membrane.

One does not make a small puncture, as was formerly advised, but a free incision, beginning it well up and carrying it down parallel with, and close to, the posterior margin of the membrane. After this the ear should be syringed with a saturated solution of boracic acid two or three times a day, and if this does not control the suppuration a solution of bichloride of mercury, 1 to 8000 to 1 to 4000, may be employed instead.

The effect upon the hearing in these cases is not usually disastrous. In the mastoid cases the impairment is often pronounced and permanent. In the milder suppurative cases, however, we expect a complete restoration of the hearing.

DR. REIK.—I would like to add a few words to what Dr. Theobald has said concerning the treatment of these cases. As Dr. Theobald has already said, there has been a larger number of cases of otitis media accompanying or following the recent epidemic of gripe than has occurred in the past. I fully agree with the method of treatment he has outlined except that I am, perhaps, in favor of incising the drum membrane at an earlier stage.

Wishing, however, to avoid an operation wherever possible, I have frequently made use of local blood-letting in addition to the treatment described by Dr. Theobald. I apply one or two leeches over the mastoid region and allow the bleeding to continue for some time after their removal. It is remarkable in many cases to note the great relief that follows almost immediately upon their application. The pain ceases to such an extent that the patient soon falls asleep and the inflammation is retarded.

DR. THEOBALD.—There can be no doubt of the value of local blood-letting in these cases.

DR. FINNEY.—I saw the case Dr. Theobald referred to, a few hours after Dr. Theobald saw her. She was then comatose, with a pulse that could hardly be counted, a temperature of 105 to 106 degrees, very high, and utterly beyond operative aid.

There was at that time no evidence that would aid in the localization of the trouble. There had been no paralysis, no muscular contractions; the pupils were of the same size and there was no evidence of any trouble or any other evidence that I could detect by examination or the history of the case, that would aid in localizing the process, and even had we gotten any idea of the location of the trouble, I thought at that time, there would have been no use in operative interference.

I saw one other case, just a day or two before this one, that

was similar in many respects, only of more happy termination. Also a young woman, sick for two or three days, had had gripe and recovered from that apparently, and a week later complained of headache which lasted for some time, only very intense she said, and always referred to right ear. After a few days she noticed a certain amount of discharge on the pillow in the morning, supposed to be from the ear, although the physician who saw her said he could find no discharge from the ear, nor was there any discharge from either ear that I could detect at the time I saw her. The drum upon that side was ruptured, she was stupid, dull, very different from the usual vivacious temperament. Could be roused enough to answer questions intelligently, but it required considerable effort to rouse her. Upon pressure over the mastoid she evinced some pain. No swelling or other evidence of mastoid trouble.

We thought it best to open the mastoid and did so and found no evidence of trouble so far as I could detect. I continued the opening in the bone until I exposed the lateral sinus and punctured that. It bled very vigorously and I came to the conclusion that the lateral sinus was not at any rate thrombosed. I drained the wound, and the patient from that time made a rapid recovery and is now entirely well.

#### Some Objections to the Neurone Theory.—DR. PATON.

The investigations of Apáthy, Bethe and Nissl have shown that the ganglion cells in the spinal cord and brain contain a specific fibrillar substance essentially different from the protoplasm of the cell body and its processes. This substance can be stained by several different methods. Little is known of its origin. It may be shown to be an integral part of the ganglion cell or it may develop from other cells in the nervous system, or it has been suggested that it may be the product of both kinds of cells.

Until it has been determined histogenetically that the fibrillary substance is a part of the ganglion cell it is an assumption to speak of these cells as units or individuals. The picture of the ganglion cell, obtained by the use of Nissl's methylene-blue method, is the negative of that given by Bethe's new stain. The achromatic tracts in the first correspond to the colored tracts or fibrils in the second specimen. Nissl believes that the fibrillary substance is present, not only in the cells, but exists in large masses in the intercellular substance and is one of the important constituents of the grey substance.

In the main the fibrils follow the distribution of the dendrites and axons. The life of the fibrils undoubtedly depends upon the preservation of the myelin sheath. There is nothing revolutionary in the new discoveries in relation to the studies of the degeneration of nerves. Little has been done in studying degenerations. Bethe has cut peripheral nerves and found that the fibrils degenerated, and that in a short time there is nothing left but granular masses. There is a great deal of interesting work to be done on this subject. Nissl emphasizes the importance of the nerve cell as a nutritive centre. If later the fibrils are proved to develop in the nerve cell, and not from other cells, it will no longer be an assumption to speak of the nerve cell as a unit.



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### A BIOGRAPHICAL SKETCH OF JOHN ARCHER, M. B.\*

BY ONE OF HIS DESCENDANTS.

John Archer, M. B., was a son of Thomas Archer, a descendant of an English family that had settled in the north of Ireland; whence he emigrated to America with several brothers before the middle of the last century; and after a brief sojourn in Cecil county, Maryland, removed to what is now Harford (then part of Baltimore) county, where his son John was born near the present village of Churchville, on the 5th of May, 1741. Besides farming, Thomas Archer was agent for several extensive iron works in the vicinity. He also drew up indentures for his neighbors, auctioned off goods, etc., and thus acquired a considerable estate. Among his other enterprises, he set up, on his own premises, a skilled blacksmith, which, no doubt, gave rise to the false assertion that he himself worked at the trade. His wife, Elizabeth (Stevenson) Archer was also of an English family that had settled in the north of Ireland. Of their five children, four were swept off in their infancy by a malignant epidemic, the subject of this sketch barely escaping death from the same disease; and from him all of the name in Maryland who are in any degree whatever related to the family, are descended.

John Archer was educated in part at West Nottingham

Academy, in Cecil county, a school of wide repute, in charge of Rev. Samuel Finley, a learned minister, its founder, who was subsequently called to the presidency of Princeton College. Among his classmates at this academy were two of Mrs. Finley's nephews, Dr. Benjamin Rush and his brother Judge Rush, with the former of whom he enjoyed a lifelong intimacy.

In 1760 John Archer graduated, A. B., at Princeton, and A. M., in 1763. Meanwhile, in February, 1762, he advertised that he would open a Grammar School in Baltimore Town. There is reason to believe, however, that this project was never initiated, as he soon afterwards entered upon the study of theology under Presbyterian auspices and progressed so far as to preach his trial sermon—which is, I believe, still extant—but, on being examined for ordination, he failed to pass the ordeal. The record of his examination by the Presbytery of New Castle is worth giving here in full, if for nothing else, as a specimen of human inconsistency as to the time-being, and fallibility as to the future. It runs to the following effect:

"30 Aug., 1764. Mr. John Archer having at last meeting of Presbety offered himself for Tryals as a candidate for the sacred ministry, then delivered a discourse by way of specimine, on a text that had been assigned him. He was also examined at some length in the Latin, Greek & Hebrew languages, his own experience in religion & on some points of divinity; but the Pb'y not having time fully to satisfy themselves thought it best not to enter him

\* Presented to the March (1899) Meeting of the Johns Hopkins Historical Club.

then on their minutes, & only recommended to him another subject for a discourse by way of specimen. Mr. Archer now delivered said discourse & was further examined on the article of experimental religion. The Pb'y upon solemnly considering the whole, do so far sustain his answers on the several Branches of Examination & particularly said Specimine, as to enter him upon further tryals, & appoint him to compose an exegesis upon the question, "*In quo fundatur obligatio moralis?*" [What is the basis of the moral obligation?] & a discourse on Romans VII. 15. ["For that which I do, I allow not: for what I would, that do I not: but what I hate, that do I."]

"6th Dec., 1764. The Pb'y proceeded to hear the exegesis given to Mr. Archer by our last, & further examined him on Logic, & asked him some questions on Divinity; & on the whole, unanimously judge that though we would gladly encourage youths who offer themselves for the sacred ministry yet think Mr. Archer through the whole course of his tryals discovers such a want of knowledge in divinity & the other particulars he has been examined on, as well as such an incapacity to communicate his ideas on any subject, y<sup>t</sup> we cannot encourage him to prosecute his tryals for the Gospel ministry any further."

Now, it is evident from the record itself that the candidate, in the opinion of the Presbytery, was well versed in all the essential branches except as to some points of the denominational creed. And as to his "utter incapacity to communicate his ideas on any subject," it is a sufficient answer to say, that the Presbytery had just declared, as the record runs, that he was particularly satisfactory in his discourse or sermon before delivered.

Col. Nathaniel Ramsay, the hero of Monmouth, is authority for the statement that he was present when John Archer underwent his trial before the Presbytery; and that his failure of ordination was "because he did not give entire satisfaction on some doctrinal points."\*

In the spring of 1765 he became a pupil of Dr. Morgan, who, in the following November, began the initiatory course of medical lectures in Philadelphia College, with Dr. Shippen as his colleague,—these two being the founders of the department of medicine in that institution, afterwards the University of Pennsylvania.

About this time he wrote as follows to his future wife:

"... I am daily at Dr. Morgan's shop, & on Mondays, Wednesdays & Fridays attend his Lectures—the Course is four Pistoles & a Dollar. Tuesdays, Thursdays & Saturday's Dr. Shippen's—the course, six Pistoles ... I have concluded to remain in Philadelphia until Spring come a year."

In February, 1767, he wrote to the same lady—then his wife—the following, which, as I believe on account of the case has ever appeared in print, may be of interest at present:

"... A monster was lately born in Charles Town [Cecil Co., Md.] in the shape of two negro children in one. They have two heads, four arms & four legs, distinctly & regularly formed; they are united from the shoulders to a little below the navels & lie in each others' arms, and each having its arm under the other's head. This wonder of nature is now in Town.—I saw it yesterday. It has been opened, & the bowels are distinct & separate, as in two infants, ought to be. One of them presented near half an hour to the world before the other & was alive at its first appearance. The

\* Col. Ramsay made this statement to my father, Dr. Robert H. Archer, one of John Archer's sons, who at that time was his family physician and who communicated it to me.

midwife gave up the delivery, which was afterwards executed by the owner of the wench, who himself understood nothing of the business. The owner is John Kirkpatrick of Charles Town."

On the 6th April, 1767, he wrote to his wife:

"... It will be some time before I can go down [to Maryland.] Dr. Morgan's Lectures will not begin before May 20th, & I am determined to hear them to the last. Dr. Bond's will not begin until y<sup>e</sup> last of May.\* However, I shall not wait for his. ... Dr. [Robert] Harris has taken Dr. Bayard as a partner in the drug business & Practice of Physic.†

April 21st, 1767, he writes to the same:

"... All prospect of entering into partnership with Dr. Boyd of Lancaster is vanished. Therefore I still have the wide world to seek where to pitch my tent."

In the summer of that year—between his second and third course of lectures—he proceeded to put into practice, among the denizens of New Castle County, Delaware, the professional knowledge which he had acquired. He, no doubt, gave this locality a temporary preference over the place of his nativity merely because it was much more convenient to Philadelphia, where his medical education was yet to be completed. His ledgers show that during his two years residence in Delaware he attended 212 families, receiving for his services about \$1000, nearly three-fourths of it in money—the remainder in rent, produce or labor, including the work of mechanics. About one-third of them paid nothing at all. There is, in his ledger, kept while practising in Delaware, a prescription, which, though a little humiliating, it is the duty of the faithful biographer to record. It may perhaps be condoned, for the reasons that it is the only one of the kind in all his ledgers, and that it antedated his diploma—though, truth to say, only a few days.

The entry runs in this wise:

"Rev. Mr. Elihu Spencer Dr. 1768 June 6th  
Milleped: pp<sup>t</sup> for your Daughter."

This, of course, was to be taken in one dose; and there being no other prescription entered for that particular patient, though the attendance upon the family was quite extended, it is fair to infer that it either killed or cured. At that date such revolting prescriptions were nearly out of vogue, though once an every-day matter. Dr. Buckler Partridge, who came from England and practised in what is now Harford county, Md., from 1715 until about 1750, was wont to dose his unfortunate patients—as his prescription book still extant amply shows—not only with millepedes, but with "juleps of goat's blood," "powdered bees," and "dried viper's flesh"; and, as if these were not enough in themselves, his favorite vehicle for conveying them into the wretched patient's stomach, was a copious draught of nauseating "frog-spawn water." And yet Dr. Partridge was the leading physician of his day thereabouts. Even "Hooper's Medical Dictionary," a standard

\* Dr. Thomas Bond at this time delivered clinical lectures at the Pennsylvania Hospital. In May, 1768, he was elected to the chair of clinical medicine in the new institution.

† Dr. Robert Harris was a brother of Dr. John Archer's wife. He was a very prominent member of the profession.



work of only fifty years ago, contains the following prescription, which, for sheer loathsomeness may perhaps be said to exceed them all: "For very obstinate jaundice: The expressed juice of 40 or 50 living millepeds given in a mild drink."

After attending his third course of lectures—Dr. Kutin having meanwhile been added to the faculty—the degree of Bachelor of Medicine was conferred upon him and nine other students on the 21st of June, 1768. This being the first occasion in America of the conferring of a medical degree, it was to be expected that even under ordinary circumstances some contention would arise as to who should be the recipient of the very first honor of the kind in the new world. Unfortunately in this particular case the decision was greatly complicated by the fact—which soon became known—that the faculty of the College, most of whom had been educated in England, wished to show their respect for the mother country by conferring the first diploma upon the only Englishman among the candidates—Jonathan Potts. But, with the recent attempted humiliations of the odious stamp-act fresh upon their memory, the glorious nine regarded this loyal concession as a downright insult. After a vain protest, they threatened to demand certificates of their successful examination,—armed with which, they would secure the coveted parchments from the neighboring College at Princeton. That settled the question. The thought of losing all except one of their graduating class, and he a foreigner, was more than the intensest loyalty could have endured. The rebels were told to arrange the matter among themselves. This they did by compromising upon the alphabetical order. It may seem a little strange that this was preferred to a decision by lot,—usually the fairest way in such cases. There is little doubt, however, that they were afraid a trial by lot might possibly give the prize to the Englishman, after all their contention; whereas, by the alphabetical plan, as they must have known at a glance, this was impossible. It is greatly to their credit, however, that they generously allowed him to come in several grades higher than he would have attained by the plan agreed upon if strictly observed,—the following being the order of graduation as given in the official catalogue: "John Archer; Benjamin Cowell; Samuel Duffield; Jonathan Potts; Jonathan Elmer; Humphrey Fullerton; David Jackson; John Lawrence; James Tilton; & Nicholas Way."

Declining an offer of partnership kindly extended to him by his preceptor, Prof. Morgan, Dr. Archer returned to his native county in July, 1769, where he practised his profession for nearly forty years. These duties, however, did not prevent him from taking part with characteristic energy in the great struggle for liberty. He was chosen in November, 1774, a member of the first local Revolutionary Committee and of the several successive committees, until August, 1776. Meanwhile, in December, 1774, he enrolled the first militia company of the county, was commissioned its Captain and drilled it regularly until called to other duties in the patriotic cause,—though forced to use a speaking-trumpet, his voice having been permanently reduced to a hoarse whisper by a severe

throat disease. The sword which he wore on these occasions is still in possession of a branch of the family. But the trumpet is long since lost, or mouldered away. For many years his sons were wont, on every 4th of July, to bring it down from among the rubbish in the old garret of "Medical Hall" and make the premises ring with the re-awakened notes of Independence.

In January, 1776, he was commissioned Major of one of the local Battalions of Militia.

In August of the same year he was elected a member of the convention which framed the Constitution of the new State and the Bill of Rights.

In 1777 he was appointed one of the Commissioners of Peace for Harford county, who constituted the County Court, and held the office for thirteen years, when the court was reorganized on a different basis. During part of this time he was also one of the Judges of the Orphans' Court.

In November, 1776, he was chosen as an Elector of the State Senate—the senators being then chosen by an electoral college.

During all this time, as his medical ledgers, still extant, amply show, he practised his profession, not only throughout several counties of his native State, but also in the adjoining State of Pennsylvania.

After the Revolution he devoted himself exclusively to his professional duties. Facilities for acquiring a knowledge of the medical profession being then extremely meagre, students from far and near placed themselves under his tutorage. He built a substantial stone office a few steps from his residence, "Medical Hall," and for a quarter of a century it was seldom that half-a-dozen young men were not under his instruction, one or more of whom, after a certain course of reading, would accompany him on his tedious professional rounds, hearing from him veritable clinics at the bedside, and on their return compounding under his directions the necessary prescriptions. After a longer apprenticeship, he intrusted exclusively to their care the less obscure and complicated cases, whose symptoms they noted and reported to him. Indeed, but for their subsidiary aid, he could not possibly have done justice to one-half the patients under his care. In several of his ledgers the visits and prescriptions of his various students are noted by their initials. From 1799 to 1794 thirteen students are thus noted, most of whom were afterwards in active practice in various parts of the country. And there were probably others. His students formed the first medical society of Harford county, which met at stated periods in the office at "Medical Hall." Some of the papers read on these occasions are to be seen, in manuscript, in the library of the Medical and Chirurgial Faculty.

In 1797 he was chosen Presidential Elector at large on the Jefferson ticket.

He and his son, Dr. Thomas Archer, were charter members of the Medical and Chirurgial Faculty, January, 1799. In the following June he was chosen one of the Examiners; and in 1802 and 1803 was on the Executive Committee.

In May, 1799, he wrote, " . . . Some person without my

\* I have often heard my father state the facts above given, which he had from his father, the subject of this sketch.

\* All the letters quoted from in this sketch, unless otherwise noted, are addressed to the subject's son, Dr. Robert Harris Archer.

Knowledge hath published that I am a Candidate for the important Place of Elector of the President. It is not my Wish, as I am certain a popular Character in Baltimore county would have a greater Chance than I could be expected to have."

In 1800 he was elected a member of Congress; and two years later he was re-elected. While a member of that body the physicians of Washington and vicinity availed themselves of his professional advice in cases which had baffled their skill. It was at this period that he discovered the interesting fact, that in the early stages of whooping-cough, vaccination will so modify the disease that its course is rendered comparatively harmless, even in winter. He also contrived and used, in cases of fractured femur, the apparatus which afterwards became famous as "Physick's modification of Desault's apparatus."

On the expiration of his second congressional term he resumed the practice of medicine. But the following, from one of his letters written at the seat of government, in April, 1802, more than hints of the strong man's failing vigor: "I shall be a very valetudinarian, and in my old days begin to investigate what will best agree with me, who once knew no difference in any kind of diet; who could eat anything without fear that was suitable for nutrition. But those days are gone with the days before the Flood."

A few years later, partial paralysis, the sequel of an attack of rheumatism following a severe fall, unfitted him for the discharge of his professional duties. He relinquished all active pursuits and his health gradually declined. The end came on the 28th September, 1810, when he expired suddenly, in the 70th year of his age, at his home, while sitting in his easy chair,—an asthmatic ailment for some days before his death precluding a recumbent posture.

A marble slab over his grave in the burying-ground of the Presbyterian church at Churchville gives merely the dates of his birth and death. Of that church he was a member for nearly half a century.\*

Extracts from a few of his letters (some two dozen of which are still extant, written in great haste, nearly all of them to his son Dr. Robert Harris Archer, then practising his profession in Baltimore), will give glimpses of him not only as a physician, but as a parent, a Christian, a patriot, and a politician. In a letter of date May 31, 1798, he advances the theory, that—

"While the country in this section, which I distinctly remember as far back as 1750, was covered with Oaks, Willows, Maples, Beeches, Alders, Chestnuts, etc., which are Astringent and Antiseptic, the rain which ran off from their Roots into the Streams & Swamps prevented Sickness, as Salt in the Ocean prevents it. And in proportion as the Country was denuded of these natural Antiseptics, Fevers prevailed. In other words they prevented

\* Of him, Dr. Mitchell of New York, said: "He left the world full of years and full of honors. His life was fully devoted to the service of his fellow-creatures and to the glory of the great Redeemer. As a physician he was beloved in a peculiar manner by all who knew him. His early piety, ripening into maturity with his years, enabled him to meet death with persuasion of his acceptance with God."

Putrescence of both vegetables & Insects, which is the Cause of Remittent & Intermittent Fevers. . . . Crowded & dirty Cities are nurseries of Putrefaction."

"July 12, 1798. . . . The Physicians of Philadelphia & Baltimore now succeed in curing Croup with Rad. Senekæ, though the disease was before almost *opprobrium Medicorum*. But they are so obstinate, they will not acknowledge it, because they were not the first to discover the remedy. I was informed when in Philadelphia that Dr. Kuhn has not lost a Patient since he has used the Senekæ. I would, before I close these observations, just remark that the cure could be expedited by dipping a cloth in a hot decoction of the Senekæ, to be held frequently near the Patient's mouth & nose, that the vapor may be inhaled & come in contact with the membrana trachealis. This I would not communicate to any of the unbelieving gang—*Si volunt desipi, desipiantur*."

In a letter without date, but probably written in 1798, he says:

" . . . The proper time for repeating the Cortex Peruviana I have found from experience to be the 7th or 8th day. Dr. Moons [one of his former students], in his Thesis [at the University of Edinburgh], has not given me credit for this practice, as he should have done. It is not to be found in any practical work before that date, unless in a very vague way—no precision is determined—no time set apart for taking it, to counteract the Return of the Fever.

"This is a hasty scribble, & as such you will take it."

"Harford County, Sep. 4, 1800.  
" . . . I am of the opinion that the seat of the disease [yellow fever],\* is in the *primæ viæ*—that the septic gas impregnates the saliva, water, & especially meats; that taken into the stomach it acts as a ferment, & according to the concentration of the Gas, is the violence of the Disease. Its state of concentration may in general be judged by the color of what is vomited & the Factor of the motions. The different degrees are *green, brown, coffee-coloured & black*. The nature of this Gas, from the experiments I have made, is an acid; therefore, this year I have exhibited Absorbents very freely by Glyster, with occasionally Laxatives & Laxative Glysters until the motions ceased to be fetid. I have given the Absorbents every two hours & ordered Glysters every four hours with the happiest effect. When the excessive stimulus is taken off the fever soon intermits & the Bark is given with the best results. The lowness of the Pulse is from the excess of the Stimulus in the Intestines; when this is corrected, the pulse becomes fuller. Bleeding, in some cases, may be advisable to lessen the effects of stimulus; otherwise, it is not indicated. When it is used very largely the Patient may die by great Debility. Cathartics are absolutely necessary, not only to remove the Septon, but to carry the Absorbents soon through the bowels. A large dose of Absorbents should be given with the Cathartic, & a Dose after every Motion. Care should be taken that the Patient does not become costive, as the Absorbents are apt to be formed into hard Excrements difficult to evacuate.

"I have not time to be more particular. I could show the rationality of this method—that it accords with Philosophic Principles. Should it succeed with you, it will give me Pleasure. It will be a new mode of treating the Fever; & the cause of the Fever will be better known."

His treatment nearly one hundred years ago, as above given, was almost identical with that so strongly recommended by recent writers,—among them Dr. Sternberg, Surgeon-General

\* The son to whom this letter is addressed was at the time Physician to the special Yellow Fever Hospital in Baltimore, and narrowly escaped death from the disease a year or two later.

of the United States Army, who also expresses the same view of the nature of the disease: namely, that its seat is in the intestinal canal and that alkalies (absorbents) should be administered to neutralize the acids which favor the production of yellow fever germs.\*

"Harford County, Sept. 19th, 1800.

"I am sorry to hear of the deplorable condition of Baltimore. . . . We have had two or three cases of Yellow Fever that originated in the county, & two or three from Baltimore have died. One of them refused to take medicine. One of them was in a cold Sweat, & vomiting dark, coffee-coloured Bile; arms and legs with purple Spots—was cured with Absorbents, opium, laxatives & Bark—absorbents & Opium given very freely—laxatives to prevent Constipation, & Bark as a Tonic."

The following was also written in September, 1800:

" . . . I am anxiously concerned for you, dwelling, as it were, in the midst of Death. Such chastisement by Divine Providence should lead the contemplative mind to God & our Saviour. . . . I hope you will be careful to avoid bad company of all Sorts, & when time & the situation of your Patients will admit of it, you will, on Sundays, attend some place of Divine Worship. The neglect of our Worship of the Supreme Being is the forerunner of the Sinking of a good Moral Character. When the Attendance on the Duties required by the Christian Religion is neglected, there is then a gradual Decline from one degree to another, until we are even brought to deny the Reality of that Religion & turn Deists. The Christian Religion holds forth Rewards & Punishments—eternal Happiness or Misery—on the purest Principles for the good ordering of Society while here, & our eternal Welfare hereafter. Relinquish the system of revealed Religion, then, on what foundation can you build your hopes of Futurity? The Answer is plainly, On none—or on a State of uncertainty. Miserable state—to be lost in Doubt & Difficulties in a matter that should so greatly concern us. But perhaps some may say, 'Reason is a sufficient guide.' But six thousand years should convince us that, unaided by Divine Revelation, Reason has run into every extreme, every folly, every wickedness. Has not Reason prompted the world in different ages to worship men, beasts, stocks, stones, & even to sacrifice their children to appease a senseless Deity & quiet their Consciences? It may be said that this was not consistent with Reason—it was madness, folly & stupidity. But why do we say so? Because Divine Revelation hath enlightened us: and even Infidels & unbelievers are benefitted by the rational Truths contained in the Holy Scriptures."

Washington, Feb. 26th, 1802.

" . . . From what I am now going to write, you will doubtless think that I make Absorbents a grand Catholicon in Medicine. If you did, it would be nearly true. Since I have been here, I have directed their use in a variety of cases, & they have never disappointed my expectations. The Patients have been relieved, & if they laboured under a Fever, the fever, after the use of Absorbents, was of short duration; & the Effect produced is founded on the most rational Principles."

Here are extracts from two letters written in Cecil County, in September, 1799, in which, although Æsculapius occasionally flits before us, he is soon fain to hide his diminished head amid the distracting hubbub of war and politics. Could they now be read by the Presbytery which pronounced him "utterly incapable of expressing his ideas upon any subject," it is not impossible that that venerable body, while they might notice in the letters anything to cause them to regret his absence

from the ministry, might be disposed to assign some other reason for excluding him therefrom.

" . . . The news tells us Republicanism is expiring. This comes from the hotbed of Royalty. I am sure, if I admit one fourth of what they relate, I should have a Right to claim by Act of Supererogation. I believe it is right the French should be drubbed. I do not mean finally, but as a chastisement for their many errors & cruelties. [This refers, of course, to the excesses of the French Revolution.] They have been as despotic as the Tyrants they have opposed, & royal Gold has showered down on numbers of them, that they might betray, or at least do acts unworthy of true Republicans. I believe that the King of France was the tenth Horn of the Beast—if so, it was the first that was to be destroyed. Others are also to be destroyed. . . . Then will the Beast & Kings & Emperors fall together into the Bottomless Pit—that is, a State of Neglect—degraded, despised, & at last forgotten."

It is rather amusing that one who, on all occasions, was utterly fearless in expressing his political opinions, should close his letter in this abruptly subdued tone: "Although you may speak of Politics with your Friends, I think you should be cautious that you offend none—no, not a little one."

In the other letter, of date a week later, he writes:

" . . . When I wrote you last, I stated, that from the Head of Tide upwards, the bilious Fever was general, but that it did not extend far from the River. I can now say it has gone up the Creeks & even the Branches that empty therein. It is like the murderous Suwarrow, who goes where he is not wanted & destroys without mercy; but it is unlike him in this particular—it spares neither Aristocrat nor Democrat, neither Republican nor Monarchist. The Friend to America & the Friend to Britain are all involved in the common fate of the Country."

"What do the dear, dear Friends of Britain think of the Condemnations at New Providence & Jamaica? I trust it will become an Emetic—that they may emit their Monarchy & their Aristocratic Principles. . . . Will America tamely say that the French are the only Pirates, Murderers, Plunderers, Floggers in the World, when, in Nassau, there has been condemned of American Property in the Month of August to the amount of 293,000 Dollars? Will not this open the Eyes of Americans? Why was it done? Because the President has dared to appoint Envoys to treat with France?"

In haste, I am," &c.

A sketch of him, which I have not seen, is to be found in Lanman's "Biographical Dictionary of the American Congress." In 1826 Dr. Revere, contemplating the publication of his "Biography of Eminent Physicians of America," wrote to one of Dr. Archer's sons for facts in his career. The following is an extract from a fragmentary sketch prepared in compliance with the above request, but never sent, being afterwards found among the son's papers:

"Dr. John Archer proved himself an able physician during an arduous practice of about half a century. He was successful in many of the important operations in surgery; and as an accoucheur, for judgment and dexterity, was not surpassed by any who had gone before him in the medical world." . . .

In "Hooper's Dictionary, edited by Samuel Ackerly, M. D.," may be seen the following:

"Archer, John, M. D. of the State of Maryland: a celebrated practitioner of medicine. Many contributions of his on various subjects of medical science are to be found in the New York *Medical Repository*. He was the first to introduce seneka snake-root (*polygala senega*) as a remedy in croup. He died in 1814."

\* Md. Medical Journal, November, 1889.



The date of his death here recorded is, however, incorrect. It should be 1810. His degree, as given above, is also erroneous; it should be M. B. He was "Doctor" only by courtesy,—having never applied for the second degree. The institution in the first year of its existence adopted a rule that two degrees, M. B. and M. D., should be conferred with three years intervening. In 1792 this rule was discontinued and only the degree of M. D. was conferred. The official catalogue states that very few applied for the Doctor's degree during the early years of the college.

As regards his contributions to the *Medical Repository*, referred to by Dr. Ackerly, I have seen only two of them, describing cases which occurred in his own practice. One was that of a white woman who gave birth to twins—one white, the other black. She was the wife of a toll-gate keeper on the turnpike leading eastward from Baltimore. She confessed that after her husband had left her bed early in the morning, a negro entered her room before she had risen, with whom she had connection. The other case was that of a man whose stomach was cut open by a cobbler with a shoe-knife—the cornbread and cabbage which he had recently eaten rolling out upon the floor. The cobbler sent at once for Dr. Archer, but, being terribly frightened by his own act, sewed up the wound with a wax-end. The doctor let it remain as he found it, and the patient recovered.

His love-letters, written while pursuing his medical studies in Philadelphia, though silly enough in their exuberant endearments, are not a whit more so than those of the average man on such inevitable occasions. Fortunately, he attempts poetry—the *sine qua non* of the infatuated lover—but once; and the quality thereof shows unmistakably that he knew infinitely more of Medicine than of the Muses.

In October, 1766, while pursuing his studies, he came on to his native county and married the lady upon whom these endearing terms had been lavished. She was a daughter of Thomas Harris, of Pennsylvania, who had removed to Maryland. He was a member of the family that founded Harrisburg. Among his descendants of the present generation is the illustrious astronomer, Prof. Simon Newcomb. Thomas Harris, in his old days, returned to Pennsylvania and died amongst his kin in Tuscarora Valley, in 1801, over one hundred years of age—*having lived in three centuries*.

Dr. Archer, in his will (dated Sep. 23d, 1808, signed and sealed 29th Dec., 1809, and proved 12th Jan'y, 1811), devised all his estate, real and personal, to his wife Catherine, as trustee for their children (five sons) during her life or widowhood; on her death or marriage, to be divided equally among them. His real estate consisted of about 700 acres of land in one body. He directs, that as there are many persons indebted to him as a physician—many of whom cannot pay without distressing them—"my sons, who are my executors, are directed to make the following entry in cases of such as they think are unable to pay: 'Forgiven by order of the Testator.'" Accounts to the amount of several thousand dollars are so credited in such of his ledgers as are still extant. His male slaves are to be free at thirty years of age, and the females at twenty-five.

Numerous anecdotes have been handed down, which will

serve to illustrate some of the more salient points of his character.

A neighbor, who was widely known to be more ambitious of fine display than of satisfying the just demands of his creditors, undertook once (and only once), to rally the doctor on the mean appearance of his badly-groomed and awkwardly-gaited Rosinante,—and, to say truth, he was not over-nice in his selections of horseflesh. "Every hair on this horse is paid for," was the gruff, though well-merited, rebuke.

At a mixed political gathering, he got into a dispute with the sheriff of the county on some exciting party issue. The latter, finding himself worsted in argument, suddenly changed his tactics and came down upon the doctor with brute force, whereupon the assaulted party hurled the pugnacious dignitary to the ground, and was pounding him according to his idea of justice—so that the singular spectacle was presented of one man breaking the peace, whose peculiar duty it was to preserve it, and another inflicting wounds, who had made the art of healing them his lifelong study. Mr. Sheriff, however, soon cried, "Enough!" "Do you pretend to know the dose better than the Doctor, you rascal?" was the uncompromising reply; and it was not until after an additional cuff or two that the restraints put upon the sheriffalty were removed.

Soon after being placed upon the Committee of Observation, in 1775, he met in the public road, on horseback, an influential Tory of his acquaintance, who accosted him in a very excited and insolent manner, when the following colloquy took place:

*Tory*.—Well, sir, I understand you are part of what is called a Committee of Observation?

*Doctor*.—I am, sir.

*Tory*.—And pray, sir, what's the purpose of the d——d thing?

*Doctor*.—To keep an eye on such scoundrels as you; and, if necessary, thrash them.

The Tory, a powerful man, now leaped from his horse and advanced, as if eager for the fray; but finding the doctor was operating on a corresponding line with characteristic energy, he remounted without loss of time and rode off.

He was wont, when coming upon a party engaged in long-bullet rolling—then much in vogue—to dismount and take part—with the invariable result of beating them all.

Occasionally, when nearly worn out by professional duties, he would steal off to some hospitable home, where he was sure of a welcome, and remain until rested,—not even telling his wife of his hiding-place. A favorite resort of the kind was the home of Mr. Philip Thomas, on Mt. Ararat in Cecil county. This gentleman, (at one time, I believe, a member of Congress) whose family he attended, was always glad to have him as his guest, and was wont, when the doctor signified his intention of leaving, to place in his way several interesting novels—knowing his weakness for that class of literature. The invariable result was that the guest tarried until he had devoured their contents. This he did eagerly, but in a rather peculiar way—always beginning at the end and reading the events backward.

In his Ledger "I" is:

"Philip Thomas, Esq., Dr.  
 1797. Nov. 21st. To inoculating twelve of your Negroes, £9.  
 Nov. 27th. Ad inscend: Infect: variolæ in Filios  
 (5) et Africanos (32)  
 To staying with your Family (when in-  
 oculated) by your particular request,  
 three weeks - - - - £29.15"

The doctor's good wife, naturally enough, resented to some extent these prolonged periods of absence in unknown parts. On one occasion, when a stranger appeared at "Medical Hall," and inquired if Dr. Archer lived there, she sarcastically replied: "A man of that name gets his washing done here."

On returning, after one of those prolonged hidings, and entering the office, he found no one there; but on the study table was a pack of cards. Though card-playing was decidedly against the rules, he simply wrote on one of them, in his unmistakable chirography, "This is neither Van Swieten, Boerhaave, nor Cullen." No "devil pictures" were ever afterward seen, at least by him, in that office.

Beneath his manly character and strong intellect ran a vein of superstition, as the following family tradition will show:

About the year 1777 he dreamed, for several nights in succession, that the house in which he was then living—his ancestral home—was struck by lightning and burned to the ground. He forthwith built a house on a distant part of the farm, selecting a very low situation, doubtless to diminish the risk from lightning, and moved into it with his family. He never afterwards would allow the older house to be occupied, although it was commodious and in good repair. The dream was never fulfilled; and it was but a few years ago that the last vestiges of the abandoned edifice disappeared by slow decay. The home to which he removed is still in possession of a branch of the family and retains the name which he so appropriately gave it.

In person Dr. Archer was considerably above the medium height, possessing great bodily strength, and was endowed with a large share of both moral and physical courage. His mind was of the combative order; and although a throat disease had sadly broken his voice—perverting it into a loud, gruff whisper at its best, for the remainder of his days, and totally unfitting him for public speaking—he did not allow the affliction to exclude him entirely from the humbler field of personal controversy. With a vigorous intellect and a good education, he entered zealously the political arena, then in a state of excitement far surpassing that of our own day. Though unflinchingly earnest in the support of his party, he was too independent to degenerate at any time into the demagogue or place-seeker—too honest to be led by public opinion or to allow ambition to swerve him from his convictions of right—one of those bold, self-reliant natures, who, notwithstanding they possess infinitely more of the *further in* rather than of the *suaviter in modo*, exercise over their fellow men great influence, being admired for their strength of character and honored for their incorruptible integrity.

Had he applied himself exclusively to his profession, and especially had he been a more frequent wielder of the pen, he

would doubtless have left his impress on the medical literature of the country. But being particularly averse to the mechanical part of writing, and being not of those who "seek the bubble reputation even in the" (mortar's) "mouth," his fame as a physician must depend mainly on a few desultory pages hastily thrown off amid the distracting hubbub of war and politics. While the effect of this will be to blend with the image of the skillful physician that of the stern old tyrant-hater, it must impart to his memory a dash of that interest which will ever, it is to be hoped, cling around the names of the prominent participants in our war for liberty.

Dr. Archer had ten children, four of whom died in infancy. Of the six survivors—all sons—five selected medicine as their profession and studied under their father. The youngest of these five, George Washington, died while pursuing his studies. The other four, Thomas, Robert Harris, John and James—named in the order of age—completed their studies at the University of Pennsylvania and practiced their profession. James removed to Mississippi, where he married and died while still a young man, leaving no child that reached maturity. The remaining son—the youngest of all—Stevenson, studied law and became Chief Justice of Maryland, member of Congress, and, by President Madison's appointment, in 1817, Judge of Mississippi Territory, with *Gubernatori* powers.

Four of Dr. Archer's sons left numerous descendants, among whom the ancestral proclivity for a roving life seems not yet to have died out. Although many of them still reside in Maryland, a greater number have gone forth to other parts. Some of them live in Virginia and Pennsylvania; several in Texas; and they are becoming quite numerous in Mississippi and Tennessee, with a few in Louisiana and even in the remote State of Washington. Gen. James J. Archer who commanded a brigade under "Stonewall" Jackson in the war between the States, and died in Richmond in 1864, was a grandson of the subject of this sketch; Stevenson Archer, another grandson, was elected to Congress for several terms from the same district which was formerly represented by his father, Judge Archer and his grandfather; and many others of the third and fourth degree of kinship served with distinction in the Southern army.

Dr. Archer sat for his portrait in Baltimore about 1802—the artist being a Mr. Harrison. It was painted for his son, Dr. Thomas Archer. Dr. Robert H. Archer engaged the artist for a replica, which was at once executed, and some time afterwards a copy was made of this replica by another artist for Dr. John Archer, Jr. They are all, I believe, still in existence. The replica is now about to be presented to the Medical and Chirurgical Faculty of Maryland. Its original owner always said it was much the best of the three portraits. And he mentioned to me, as proof of its striking resemblance to the original, that many years, after his father's death, on seeing it in an unusual place and in a rather dim light, he thought, for a moment, that it was his father himself—or, rather, his apparition. A copy of this replica also hangs in the court-room at Bel Air. It was recently taken by a Washington artist, and is very creditably done.

## FEMALE POISONERS—ANCIENT AND MODERN.\*

BY CHARLES C. BOMBAUGH, M. D., *Baltimore, Md.*

One of the commentators on the works of the ancient Greek writers, says: "Among the Greeks, women appear to have been most addicted to criminal poisoning, as we learn from various passages in ancient authors." The author most frequently quoted is Antiphon, whose discourses on judicial procedure in Athens in criminal prosecutions, which appeared about four hundred and thirty or forty years B. C., are still preserved. Dr. Witthaus, the toxicologist, in repeating this observation, supplements it with an assumption which may or may not be warrantable. He says: "Women appear to have been most addicted to the crime of poisoning in the Grecian period, *as they are at the present time.*" A repetition may also be noted in Dr. Smith's Dictionary of Antiquities, under the term *Veneficium*, the crime of poisoning. Referring to its frequent mention in Roman history, Smith says: "Women were most addicted to it."

This crime has furnished a theme for novelists and dramatists all the way from the Poison Maid or Bishakanya of India in the Hindu story of the Two Kings; in the *Secretum Secretorum* of Aristotle (XXVIII); and in the *Gesta Romanorum* (XI), to Nathaniel Hawthorne's story of Rappacini's Daughter. Our modern fiction writers, however, generally select their culprits from the male sex, as for example, Charles Dickens in his "Hunted Down," and Charles Reade in "Put Yourself in His Place." Frequent references in Shakespeare's dramatic works, such as the poisoning of Regan, daughter of King Lear, by her sister Goneril, or the removal of Leonine by Cleon's wife in Pericles, show that this, as all else in human character and conduct, could not escape the grasp of the master spirit. He makes Richard II say:

"Let us sit upon the ground,  
And tell sad stories of the death of kings:—  
How some have been deposed, some slain in war;  
Some poisoned by their wives, some sleeping, killed;  
All murdered."

In Cymbeline, the king's physician, in announcing the death of the queen, surprises and startles the monarch with the revelation of her fiendish purpose to destroy both him and his daughter by a former queen, in order to clear the way for her ambitious projects:—

"Your daughter, whom she bore in hand to love  
With such integrity, she did confess  
Was as a scorpion to her sight; whose life,  
But that her flight prevented it, she had  
Ta'en off by poison.

\* \* \*  
"More, sir, and worse, she did confess she had  
For you a mortal mineral, which, being took,  
Should by the minute feed on life, and lingering,  
By inches waste you: In which time she purposed  
By watching, weeping, tendance, kissing, to  
O'ercome you with her show," etc.

Sanskrit medical writings, which date back several hundred

years before Christ, testify that the Hindus of that early period were familiar with poisons—animal, vegetable and mineral—together with their antidotes. Passages like the following show that criminal poisoning was guarded against:

"It is necessary for the practitioner to have knowledge of the symptoms of the different poisons and their antidotes, as the enemies of the Raja (sovereign)—bad women and ungrateful servants—sometimes mix poison with food."

To various warnings which follow is added the precaution, "Food which is suspected should be first given to certain animals, and if they die, it is to be avoided."

There is abundant evidence that the Persians and Egyptians, as well as the Hindus, were familiar with poisonous substances, such as the venom of serpents, the hydrocyanic acid of the peach kernel, mineral corrosives or irritants, and vegetable narcotics. In the Grecian mythology there is occasional reference to the removal of inconvenient husbands by goddesses who are familiar with the deadly properties of aconite. The manner in which Ulysses neutralized the enchantments of Circe, as related in the Odyssey, shows that attention was given at an early period to the application of antidotes. Homer also tells us of the voyage of Ulysses to Ephyra,

"to learn the direful art  
To taint with deadly drugs the barbed dart;"

and Ovid relates that the arrows of Hercules were tipped with the venom of serpents, differing in that respect from the modern South American arrow poison, curare, which is a vegetable extract. Poisoned arrows are referred to in the sixth chapter of Job, but there is no reference either in the Old or the New Testament to the use of poison for taking away life.

Of the poisons used in Greece in the historical period, and mentioned by Nicander, the favorite appears to have been hemlock. Whether it was the conium maculatum, or the cicuta virosa or aquatica, is a matter of controversy. Haller contends that the water-hemlock was the conium of the Greeks. It may be noted, however, that Pliny says that the generic term Cicuta was not indicative of a particular family of plants, but of vegetable poisons in general.

For the first circumstantial report of an instance of the class under consideration, we must go back to Antiphon, who, as already noted, lived more than twenty-three centuries ago. In one of his discourses he gives a short speech, entitled "Against a Stepmother, on a Charge of Poisoning." It treats of a case which was brought before the famous court known as the Areopagos. The speaker, a young man, is the son of the deceased. He charges his stepmother with having poisoned his father several years before through the instrumentality of a woman who was her dupe. The deceased and a friend, Philoneos, the woman's lover, had been dining together, and she was persuaded to administer a philtre to both, in hope of recovering her lover's affection. Both the men died, and the woman—a slave—was put to death forth-

\* Read before the Johns Hopkins Historical Club, Dec. 12, 1898.



with. The accuser now asks that the real criminal—the true Clytemnestra of this tragedy—shall suffer punishment.

About a century later, the most prominent as well as the most remorseless of the Greek poisoners was Olympias, the wife of Philip of Macedon and mother of Alexander the Great. This restless intrigante compassed the death of Aridæus, a natural son of Philip, his wife Eurydice, Nicanor, and many of the leading men of Macedonia who were inimical to her interests. To those who were imprisoned she allowed the choice between a sword, a rope, and a cup of hemlock; for others there was only the quieting effect of the potion that ended the career of Socrates.

Roman history abounds with cases. While there is reason to believe that in the time of the Empire unwarrantable suspicions were sometimes entertained and false accusations were sometimes brought, we have accounts of numerous murders by poison, the historical proof of which is beyond question. It is also likely that then as now there were many cases in which, in spite of moral certainties and circumstantial evidence, there was failure to convict. In the absence of the facilities afforded by modern scientific methods for the detection of crime, the law officers were correspondingly powerless to intervene, and many criminals escaped with impunity. At the same time there were occasional convictions that were based on mere suspicion. For example, Hostilia, the wife of the consul Calpurnius, accused of poisoning her husband, was thus condemned. Sometimes under the pressure of public clamor and reprobation, offenders were driven to suicide, as in the case of Piso and his wife Plancina, who were charged with poisoning that popular favorite, Germanicus, the nephew of Tiberius and brother of Claudius. Plancina's tutor and accomplice was a notorious poisoner named Martina. More renowned as a professional poisoner of the first century of the Christian era, and held in greater abhorrence was Locusta. Among the victims was Claudius, who was poisoned by order of Agrippina, and Britannicus who was similarly disposed of by order of Nero. This monsterloaded Locusta with gifts, and made her teach a selected class her processes, in order that her art might be perpetuated. In this nefarious business, Tacitus, in his *Annals*, leaves us to infer that slow and wasting poisons were usually employed. He echoes the prevailing belief of his time that skilled poisoners could regulate the effect of their doses with mathematical precision. If so, we shall have to classify their accomplishment among the "lost arts." Our only approach to it is in the latent or dormant condition and eventual outbreak of the specific virus of rabies, yet as the period of incubation runs from a few weeks to several months, we cannot predict the day of impending doom. Theophrastus says that the sorceress used aconite, which makes all the more puzzling his statement that she could regulate the toxic process so as to kill in a month or a year. There is reason to believe that combined with the aconite was the juice of the poppy.

With the secret help of such professionals as Martina and Locusta, the list of ladies connected with imperial and aristocratic families who, from motives of revenge, illicit love, political intrigue, or cupidity, destroyed those who were in their way, is a lengthy one. For the most sensational of

wholesale poisonings we must go back to the period of the conquest and the acquisition of Italian territory, three centuries B. C. We learn from Livy that many of the leading men of Rome were carried off with a seizure presenting such similarity of symptoms that it was regarded as the outbreak of a pestilence. It leaked out, however, through information given to the authorities by a slave girl, that these numerous deaths were due to poisons prepared and administered by Roman matrons. Following the clue thus given, about twenty matrons, including Cornelia and Sergia, who belonged to patrician families, were surprised in the act of preparing some drugs over a fire. Upon their strenuous assertion that the preparation was harmless, the magistrates compelled a test of sincerity by drinking it, and thus they all perished. Proceeding upon additional information as to the extent of the mischief, one hundred and seventy Roman matrons were afterward convicted and punished.

From the time of the Lombard invasion to the appearance of the Borgias on the scene of action, in the 15th century, poison was the frequent weapon of the oppressor and the protection or revenge of the oppressed. Lucretia Borgia is said to have shared in the atrocities of her infamous father and brother, though this is questioned by the modern iconoclasts who are bent on reversing history as we have been familiarized with it. During the Renaissance in Italy, poisoning became a fine art; the victims were numbered by thousands, and the female fiend was everywhere in evidence. In the seventeenth century the use of poison as an instrument of secret murder became so common as to warrant a violation of the confessional. In 1659 the priests of Rome informed the Pope, Alexander VII, of the great number of poisonings revealed to them in the confessions of young widows. Investigation led to the discovery of a secret society of women which met at the house of Hieronyma Spara, a fortune-teller, who dispensed an elixir or "acquetta" for the dissolution of unhappy marriages. After a large number of victims had been sacrificed, La Spara's practices were detected through cunning police artifice. She and thirteen of her companions were hanged; others were publicly whipped half-naked through the streets of Rome, and those of the highest rank were banished.

There was a similar society of married women in Naples headed by a Sicilian woman named Tofana, who devised the arsenical solution known as the Aqua Tofana, Acquetta di Napoli, or Aqua di Perugia. It was usually labeled "Manna of St. Nicolas of Bari." Eventually the nature of her transactions was discovered and she was cast into prison. It is said that she was strangled, but whatever her end, it is certain that she confessed, under torture, to instrumentality in six hundred murders by poison, including two Popes, Pius III and Clement IV.

Murrell says that the Aqua Tofana was made by rubbing white arsenic into pork, and collecting the liquid which drained from it during decomposition. To an irritant mineral poison was therefore added, by this vile process, a ptomaine or cadaveric alkaloid possessing properties of the highest degree of toxicity. Be this as it may, there is well-grounded belief that corrosive sublimate and opium were sometimes added to the arsenic.

In other countries there was similar activity in this line. Thierry, the historian of the Norman Conquest, for example, tells us of one queen of the Franks, Fridegonde, in the sixth century, whose life "could be summarized in a chronological table of assassinations by steel or poison"; and of another, Brunhilde, who poisoned her grandson and ten kings or sons of kings.

In Russia, Catherine I, wife of Peter the Great, noted for her scandalous misconduct, is believed to have poisoned her husband; and in France, Francis II and Charles IX were poisoned with the connivance of Catherine de Medici, wife of Henry II, who instigated the massacre of St. Bartholomew, to say nothing of the prompting of the assassination of Henry of Guise and his brother the cardinal. Catherine had in her employ a Milanese named Reni, who served her in the double capacity of perfumer and poisoner. Here, again, the backward swing of the iconoclastic pendulum has challenged the verdict of history, but historic judgment is still firm and impregnable. It is said that the attempted poisoning of Louis VI (Louis le Gros) by his stepmother, in pursuance of her inveterate hatred, was followed to the end of his life by an unnatural pallor. Hence arose the question whether the decoction used was obtained from an herb with properties similar to those alleged of the *Escargue cuminum*, referred to by the Roman poet, Horace, in one of his Epistles (I. 19).

Of the German criminals of this class, none attracted more profound attention, with one exception, than the devil incarnate known as Nannette Schoenleben. What a travesty this name (beautiful life) is upon her atrocities. On her way to the scaffold she declared that it would have been better for herself as well as for society had she been detected in her first offense and tried and executed for it. "Then," she said, "several lives would have been spared; a vast amount of suffering would have been prevented; and I should not now have had so many crimes to answer for in leaving this world."

The exception noted was a parallel case in Bremen, that of Frau Gottfried. This woman aroused general sympathy by the loss, in the course of a few years, of two husbands, her father, mother, brother and several children, thirteen in all. Their departure was followed by that of members of a family in which she was installed as housekeeper. When she was finally detected in sprinkling grains of a white powder over some meat, the news fell like a thunderbolt upon the community. It was received with stubborn incredulity. Who could believe, said her acquaintances, that one so amiable, so kindly, so pious, so tender and devoted a nurse, so universally respected and esteemed, could be guilty of poisoning her own friends and relatives? She could not, they added, see any one in pain or misery without shedding tears; while the sufferers were writhing in the agonies of death, she called on God to pity them and release them from their anguish. When she was confronted with the evidence of her guilt, the blood-thirsty demon confessed to forty murders during her career, and wrote a history of her life, the details of which are extremely revolting, especially in relation to the murder of her innocent children.

In Spain, the woman who appears to have excited the widest degree of horror and amazement was Donna Maria

Mendieta, of Madrid. In conjunction with her paramour, whose name, by the way, was Santiago San Juan, she murdered her husband. Discovery led to arrest and trial. She was one of the most beautiful women in Spain, and belonged to one of its most ancient and honored families. But the judges were inflexible, and both she and her lover were sentenced to death and executed.

In England the most noteworthy case in high life was that of the Countess of Somerset who poisoned Sir Thomas Overbury, in the Tower of London, in 1613, with corrosive sublimate. As Lady Essex, she had procured a divorce from her husband in order to marry Robert Carr, Earl of Somerset. Overbury was in possession of incriminating facts concerning Lady Essex which would have been fatal to her success, and he was put out of the way ten days before the decree of divorce was pronounced. More than two years elapsed before circumstances led to the discovery of her crime. She was found guilty, but was pardoned by James I. This leniency was in marked contrast with the treatment of those who had no friends at Court. A statute of Henry VIII ordered poisoners to be boiled to death, and in accordance therewith it is related that a young woman who had poisoned three families at Smithfield was boiled alive.

In the course of the latter half of the seventeenth century a mania for secret poisoning was developed in France which extended to all classes of society. La Spara and Tofana had fitting types and imitators in Paris in two midwives and fortune-tellers named Lavoison and Lavigoreux. So great was their traffic in poisons, and it may be said, so fashionable, that their houses were thronged with purchasers, both of high and low degree, from Paris and the provinces. The usual motives and incentives were in full play, jealousy, revenge, avarice, court intrigue, political enmity, and removal of all obstacles that stood in the way of iniquitous plans and projects. To suppress and punish this class of offenders, a special tribunal was established in the reign of Louis XIV, known as the "Chambre Ardente." Lavoison and her confederate were condemned and executed in 1680, and their accomplices in various cities of France, to the number of more than one hundred, were burned or beheaded.

Although various noxious solutions were employed by these monsters, the Aqua Tofana appears to have been the favorite. With reference to its results we need not confine ourselves to the annals of medical jurisprudence, for, as has been observed, poets, novelists, and historians have delighted to linger on this chapter of criminal lore, and to paint in vivid colors the tragic scenes which, in Italy, France, and Germany, were enacted by the miscreants who administered the fatal dose with murderous intent.

Of the poisoners of the aristocratic class at that period, none commanded such widespread interest, and none is so well remembered as Marie-Marguerite d'Aubray, la Marquise de Brinvilliers. Here was a woman with every advantage of high birth and position, of large wealth, of influential connections, of singular beauty, of fascinating manners and elegant accomplishments, recklessly throwing all away in the attempt to substitute a scoundrelly lover for a reprobate husband. This lover, Gaudin de Sainte-Croix, who while



incarcerated in the Bastille, in company with the Italian chemist Exili, had learned from him the preparation and application of poisons, so far as then known, became in turn the instructor of the marchioness. This Jezebel in order to test the efficacy of the materials which St. Croix supplied, and to qualify herself for the sure destruction of her father and her two brothers, who antagonized her shameful amour, visited the hospitals, particularly the Hotel Dieu, day after day, in the guise of a sister of charity, to experiment upon helpless invalids. In the course of this diabolical work she often produced effects as mere aggravated symptoms of the maladies she was ostensibly endeavoring to alleviate, and while outwardly gentle, tender, compassionate, and sympathetic, she succeeded in sending a large number to the dead-house without incurring suspicion. St. Croix afterward lost his life by inhaling deadly fumes in his laboratory; letters compromising the marchioness were found in his cabinet, and she escaped to Liège, but was eventually decoyed from a convent in which she had taken refuge, and brought back to Paris, tortured into confession, and beheaded on the scaffold in the Place de Greve. The best narrative of her romantic career may be found in the admirable historical novel of Albert Smith, better known as an entertaining writer than as an English surgeon.

Coming down to our times, we find in the governing motive a largely diminished ratio of the instigation of the earlier days. Secret poisoning for the removal of people inconveniently in the way of the advancement of wicked ambition, both in domestic and public life, has been displaced to a great extent by the promptings of mercenary rapacity. Vengeance as a mainspring has been transformed into the pecuniary profit that accrues from the death of the victim. In the way of temptation to the flagrant exercise of the avaricious propensity, the life insurance system has innocently widened the range of moral hazard, both in this country and in Europe. But, as we too well know, every organization in the social economy is liable to abuse. How often is the beauty of holiness tarnished by the hypocrites who use the Church as a cloak; how often the holders of fiduciary trusts become defaulters; how frequently the incumbents of official position defraud the government. A system whose outcome proves it to be the best form of organized philanthropy yet devised, cannot be held responsible *per se* for such criminal perversion. That it should so unsex the daughters of Eve, and so metamorphose them into fiends, as the life and accident insurance companies too often have occasion to experience, is a matter for infinite regret.

A complete catalogue for the nineteenth century of the special class of cases under consideration in Europe and America, either under indictment, or subject to the suspicion that is allied to moral certainty, would occupy the entire time and space allotted to this paper. A few instances, taken from the experience of life-insurance companies, will serve the purpose of illustration. That which leads all others in the extent of atrocity is reported from Hodmezo, Hungary. During the trial, a few months ago, of two Hungarian peasant women, named Jager and Cordas, startling disclosures were followed by confessions of murders numbering several hundred. Their operations were conducted on the plan of the

speculative transactions in Pennsylvania and other States, commonly known as graveyard insurance, in which the lives of consumptives, hopeless invalids, paupers and octogenarians were made the subjects of gambling policies without their knowledge or consent, and were hastened to their end by violent measures. In such cases the principle of insurable interest is ignored, and medical certificates are forged. In the cold-blooded procedure of the Hodmezo conspirators the companies involved were small local beneficial or burial societies, and the amounts at risk were little beyond ordinary funeral expenses. Hence, to make their traffic in human life remunerative, it had to be carried out on a large scale.

Next to this bad eminence or championship was a woman named Van der Linden, in Leyden, Holland. In the latter part of 1883 she was arrested on a charge of having destroyed sixteen lives, most of the victims being members of her own family, including five of her children. She had had their lives insured for her benefit, and received the amount of the policies after their deaths. She confessed her guilt, but her story was so incredible in the boundless wickedness it revealed, that most persons were inclined to reject it in its full extent, even on the assumption of homicidal mania.

In Liverpool, two sisters named Higgins and Flannagan were indicted in 1884 for the murder of four of their relatives, and on trial were convicted and punished. At Deptford, adjacent to Greenwich, Elizabeth Frost and her mother, Mrs. Winters, in 1889, disposed of three cases in similar fashion. Soon afterward Mrs. Winters died, whether purposely poisoned, or whether she committed suicide, is unknown, and, finding her end approaching, made full confession of her guilt. From her dying statement it appears that she preferably employed "white precipitate," but how or why an ignorant woman like her was led to select the ammonium-chloride—to which there is so little recourse—instead of the bichloride of mercury—which is so frequently resorted to—can only be left to conjecture.

With respect to social position, there is a wide gulf between these coarse and vulgar reprobates and such society leaders as the Belgian aristocrat, Madame Marie Therese Joniaux, whose trial at Antwerp, four years ago, for the murder of her sister, brother, and uncle, all insured in her favor, created a profound sensation. She was the daughter of General Ablay, a distinguished cavalry officer; had been brought up in an atmosphere of refinement and cultivated taste; had been twice married to men of superior rank, and had moved among the best social circles of Brussels and Antwerp. But down in the depths of her moral sense she proved to be as depraved, as vicious, as impenitent as the low-born wretches to whom we have referred. Her love of luxury and display and her passion for cards exhausted her fortune, and her nearest relatives were sacrificed to repair it. Yet she was so far above suspicion that it was only the rapidity with which the claims successively matured, and the impetuous and indecent haste with which payment was claimed, that led to her betrayal.

On this side of the Atlantic, the worst case, according to court records, though not the worst in point of fact, is that of Mrs. Sarah J. Robinson, of Somerville, Mass. In 1885, this stony-hearted woman deliberately destroyed the members of



her family, seven in number, one after another, but thanks to the interposition of criminal lawyers and the interference of morbid sentimentality, she has escaped the hangman's rope. In a similar way, another home-destroyer, Mrs. Lizzie Brennan, who killed her husband and two sons at Holyoke, in 1889, evaded justice. With one exception, it should be noted that the entire gang of female poisoners in this country have escaped capital punishment. While this result is usually due to the sympathetic acquittal or the short-sighted disagreement of the juries before whom such cases are tried, there are times when, as in the case of the infamous matricide, Frankie Morris, of Kansas, they are inflexible, and an obviously just and conclusive verdict is neutralized by the subsequent crafty juggling of cunning criminal lawyers. Twenty-five years ago Mrs. Victor, of Ohio, managed her own escape by singing herself with Ophelia-like plaintiveness into the safe shelter of an insane asylum, and thereby into commutation of the death sentence. But that trick cannot be successfully repeated at the present day. The exception noted, to the credit of a Philadelphia jury, was that of Mrs. Sarah Jane Whiting, who was executed in Moyamensing prison, in 1889, for the murder, by arsenical poisoning of her husband, her daughter aged 9, and her son aged 3, to obtain the paltry amount of their industrial policies, a total of \$399.

Aside from sociological considerations, our interest in these cases centers mainly in their relations to medical jurisprudence, medico-legal science, forensic medicine, and especially forensic toxicology, and the present attitude of expert evidence. Questions arise with which we have no concern, and which we leave to the ministers of the law; for instance, the recent dispute between the authorities of California and the authorities of Delaware as to which should hold for trial the woman Botkin, who is charged with the craftily planned death of Mrs. Dunning and Mrs. Dean, in Wilmington, by poisoned candy transmitted through the mails. That question having been settled, it is now time for the reinforcement of legal chemistry. One of the most perplexing contentions on the part of the defense which the prosecution is compelled to meet is the concordant responsiveness of ptomaines, the alkaloids of putrefaction, to the general reagents for such alkaloids as morphine, strychnine, coniine, atropine, veratrine, etc. In the *Sonognia* trial at Cremona, Italy, and in the *Lamson* trial in London, it was contended that the alleged presence of morphine was mistakenly identified as that of ptomaines, the reaction being the same. The analysts, urged the defense, were not warranted in asserting the existence of a vegetable alkaloid in putrefying material from the affirmative results of the reactions alone. Baumert goes so far as to insist that "in one case the ptomaines in question not only gave various chemical reactions, including the identifying reactions of strychnine, but also possessed the tetanizing action of that alkaloid." In view of such behavior of the spontaneously generated toxic products of putrefaction toward the general reagents, it is not to be wondered at that in the case of Madame Joniaux, at Antwerp, her defenders fell back upon such a convenient theory in spite of the evidence that morphine was found in the intestines of her victims, and that she

had repeatedly obtained morphine from Brussels chemists on forged prescriptions.

A case which attracted wide-spread attention was that of Madeline Smith, of Glasgow, who was tried in July, 1857, for the murder of her lover and seducer, Pierre Émile L'Angelier. He sought to crown his perfidious conduct with marriage, but her parents, not knowing of their illicit relations, forced an engagement to marry a man of their choice, Mr. Minnoch. Thereupon the revengeful scoundrel exposed to friends of the family Madeline's piteous letters to him with reference to her *enfermé* condition, and drove her to desperation. The indictment read, "administering arsenic or some other poison in coffee, cocoa, or some other food or drink, in February, 1857." The trial ended with the Scotch verdict, "not proven," to the great relief of the community, everybody being in sympathy with the defendant. In the course of the analytical evidence, several chemico-legal questions were involved, one of the most important of which related to the degree of solubility of arsenic. In the stomach of the deceased the chemists found ninety grains of arsenic either dissolved or suspended, and there was arsenic enough in the intestines to cause violent purging. This, by the way, was seized upon by the defense as consistent with the theory that the deceased died of cholera morbus. But while the crown contended that the arsenic had been administered in coffee or chocolate, the defense claimed that it was impossible that such a quantity could have been taken unconsciously by the deceased in these or any other liquid media. With reference to this view, Withaus very properly notes that it presupposes that solution is a requisite to secret administration, but while this may be true of a transparent medium, and where the victim is in the possession of his senses, it must not be forgotten that a much larger quantity than could be dissolved may be stirred into a thick and opaque liquid, and taken without producing any effect upon the senses, except possibly a rough taste or gritty sensation. As to grittiness, it may be noted parenthetically, that such crystalline particles could hardly measure up to the standard of the crushed and powdered glass which, in October, a Battle Creek, Michigan, wife of 28 years commingled with the breakfast oatmeal for her husband, a capitalist of 80 years of age. It proved to be quite as potent as the destructives in more common use.

In the case of the American notoriety, Florence Elizabeth Maybrick, tried in Liverpool, in 1889, for the murder of her husband, James Maybrick, it appeared in evidence that the cause of death was gastro-enteritis, which, it was contended, had been induced by an irritant poison. On searching the house, eighty-five grains of arsenic were found. It was proved that James Maybrick was addicted to dosing himself with drugs, that arsenic in minute quantities was one of them, and that not long before his death he had purchased two and a half ounces of it. Even admitting the self-administration of fractional doses, arsenic is not cumulative in the ordinary sense of that term. In discussing the relation between absorption and elimination, it was shown that by the excretory action of the stomach none was left in that organ; that it was chiefly localized in the liver, and minutely disseminated in other organs. Death occurred on the eighth day after the

supposed administration of the arsenic, and this lengthened interval once more brought up the question of possible duration. While the usual period of fatal poisoning is not prolonged beyond twenty-nine hours, there are cases on record in which the end was delayed for twenty-four days. Though the trial, which lasted six days, was largely a battle of experts, it ended in conviction and sentence. As to the motive, the inherent probabilities point less to the amount of insurance on the husband's life than to improper intimacy with another man, and a desire to exchange Mr. Maybrick for Mr. Brierly.

In the Wharton case in this community, in 1871, there was a singular perversion of justice through the quibbling and subterfuge of the experts employed by the defense. It emphasized the conviction that ingenious sophistry may so confuse the judge on the bench, and so confound the jury in the box, that Justice will lend her weight to the wrong balance, and prosecution of guilt will be interpreted as persecution of innocence. Mrs. Eliza G. Wharton was tried at Annapolis on the charge of poisoning her old army friend, General W. S. Ketchum. Several physicians of acknowledged reputation and exalted character testified that Ketchum died from non-natural causes, in other words, from the administration of poison, and three well-known analytical chemists testified that tartar emetic was found in the stomach and viscera, and metallic antimony in the liver. On the other hand, the defense insisted that the death was due to a natural cause, that it was the result of disease, and that the disease was cerebro-spinal meningitis. The witnesses for the State showed that the symptoms and post-mortem appearances were consistent with the theory of poisoning by antimony, and showed, moreover, that the preceding history of the case and the absence of the characteristic lesions precluded the idea of death from cerebro-spinal meningitis. Their position was strengthened and corroborated by the simultaneous attempt to poison Mr. Eugene Van Ness, first with prussic acid, next with strychnia, and finally with tartrated antimony. In both cases the motive was based upon money considerations. The object of the experts for the defense seemed to be not so much to develop scientific truth as to criticise the witnesses for the State, to contend that their testimony was colored by prejudice, and, in one way or another, to impugn their motives.

In thrusting forward their audacious assumption, their leader and chief spokesman was Dr. Edward Warren. In his magisterial way he declared that "the case of General Ketchum, from the first pain to the last convulsion, in all its phases, bearings and combinations, illustrates nothing more nor less than a typical example of that form of cerebro-spinal fever to which the name of fulminant has been so aptly given as indicating the suddenness of its invasion, the intensity of its phenomena, the rapidity of its march, and the fatality of its termination." Dr. Warren was supported in his position by several fellow-experts, but it was his own brilliant sophistry that led to disagreement of the jury and escape of the prisoner.

This is neither the time nor place to discuss diversity of opinion respecting questions in dispute in these cases. But a word in passing may be admissible with regard to the interested arguments of experts who are virtually employed and paid as counsel, especially in the line of defense. Common fairness and simple justice demand that both sides of the issue shall be clearly presented, but the Wharton case and similar cases go to show that the expert who has a client to serve, and accepts liberal payment for his services, may discredit this branch of medical practice by constructing a theory or framing an argument so plausible, so ingenious, so persuasive, as to mislead the jury, capture an acquittal, and distort the machinery of justice. The remedy lies in making the position a permanent one in the State, with judicial appointments from the ranks of demonstrated capability and scientific training. We should follow the example of Germany, where, we are told by Casper, "in criminal cases the experts first summoned are exclusively those whom the State, after prior examination of their competency and skill in such particular inquiries, has duly authorized to act for this purpose; while in addition to this, there is organized a tribunal of experts to which the opinions of expert witnesses can be referred." Some of our writers on medical jurisprudence have shown how a similar system can be grafted on our American practice. All that is needed to place our expert evidence upon a higher plane and to bestow upon it a larger measure of respect and confidence is appropriate and readily attainable legislation.

## THE HISTORY OF THE MEDICAL DEPARTMENT OF TRANSYLVANIA UNIVERSITY AND ITS FACULTY.\*

BY WILLIAM JEPHTHA CALVERT, M. D.

The name Transylvania was first given to that tract of land included between the Ohio, Cumberland and Kentucky rivers. This territory was bought from the Cherokee Indians by Col. Richard Henderson and others for the purpose of establishing a separate and independent government under the sovereignty of Great Britain. The General Assembly of Virginia declared

this purchase illegal, and Colonel Henderson was forced to be satisfied with a grant of land on the Ohio at the mouth of the Green River. On December 31, 1776, Kentuckee County, including all of the present State, was established by the General Assembly of Virginia, and three years later Col. Robert Patterson and others began the erection of a fort where Lexington now stands. The newly established county, separated from civilization by the mountains and overrun by a thieving and warlike tribe of Indians, offered to the youth

\* Read before the Historical Society of the Johns Hopkins Hospital, December 14, 1897.

no encouragement for education, refinement, or the study of the sciences.

By request, the General Assembly of Virginia, in May, 1780, to counteract these harmful influences, endowed the inhabitants of Kentuckee County with certain lands for educational purposes. This act, donating eight thousand acres of escheated lands to William Fleming and others, as trustees, was the first charter of the school to which, in 1783, was given the name of Transylvania Seminary, and sixteen years later that of Transylvania University. After ten years of religious and political rivalry the seminary was permanently located at Lexington, Ky., with Mr. Moore as its Master. The election of Mr. Toulmin to the Presidency, in 1794, was bitterly opposed by the Presbyterians, who subsequently founded the Kentuckee Academy at Pisgah. Dissatisfaction having already arisen in the new academy, the resignation of Mr. Toulmin from the Presidency of Transylvania Seminary, in 1796, brought about a friendly relationship between the two institutions, which resulted in their union. The new school was called the Transylvania University. The Legislature of Kentucky was afterwards petitioned for a new charter, which was granted December 22, 1798, to take effect January 1, 1799.

The founders proposed to make the new university complete in every branch. The Law and Medical Departments were immediately established, and the libraries and laboratories were equipped as rapidly as possible. The Rev. James Moore was the first Acting-President and Professor of Logic, Metaphysics, Moral Philosophy and Belles-lettres; Rev. James Blythe, Professor of Mathematics, Natural Philosophy and Astronomy; and Rev. Robert Stuart, Professor of Ancient Languages. The Law Department was formally established by the appointment of Mr. George Nicholas to the Chair of Law and Politics. The appointment of Dr. Samuel Brown to the Chair of Chemistry, Anatomy and Surgery; and Dr. Frederick Ridgely to the Chair of Materia Medica, Midwifery and the Practice of Physic, was the beginning of the Medical Department.

From the newspapers of this time we learn that the Medical Society met each week for the reading of original papers and the discussion of current topics.

Dr. Walter Warfield was, in 1801, appointed Professor of Midwifery, and in 1805 the Chair of the Theory and Practice of Medicine was occupied by Rev. James Fishback, M. D.

On account of the small number of students, and for other reasons not recorded, the faculty as a body resigned in 1806. An attempt to reorganize the faculty was made in 1809 when the following professors were appointed: To Anatomy and Surgery, Dr. B. W. Dudley; to Surgery and Obstetrics, Dr. Elisha Warfield; to the Institutes of Medicine, Dr. Joseph Buchanan, and to the Theory and Practice of Medicine, James Overton. Nothing was accomplished by this reorganization. A second attempt was made to reorganize the faculty in 1814, but all of the professors resigned before entering upon their duties. Dr. Dudley,\* however, lectured to about fifteen students.

In 1816 a third attempt was made to reorganize the faculty. The following appointments were made: To the Chair of Theory and Practice of Medicine, Dr. James Overton; to Anatomy and Surgery, Dr. B. W. Dudley; to Chemistry, Dr. James Blythe, and to Obstetrics, Dr. W. H. Richardson. In December of the same year Dr. Drake was called as Professor of Materia Medica and Botany. In the fall of 1817 the Medical Faculty was fully organized as a department of the University, and a full course of lectures was delivered to about twenty students, at the end of which the degree of Doctor of Medicine was conferred, for the first time in the West, on John McCollough, of Lexington, Ky.

Dissatisfaction caused the resignation of Drs. Drake and Overton, in 1818, the former going to Cincinnati, Ohio, the latter to Nashville, Tenn. A controversy between Drs. Dudley and Drake, in regard to the resignation of the latter and some matters connected with a post-mortem, resulted in a challenge to mortal combat from Dudley to Drake. The latter declined, but his friend Richardson accepted the challenge. A duel resulted in which Richardson was seriously wounded in the groin, and from which he would have speedily bled to death had it not been for the ready skill of Dudley, who immediately checked the hemorrhage.

While the Medical Department was struggling against adverse circumstances, the Academical Department fared no better. The Trustees had, on several occasions, offered the

moved to Lexington, Kentucky. His early education was scanty, and of the languages he knew nothing. His medical studies were commenced under Dr. Frederick Ridgely, of Lexington, Ky., and in 1804 he attended lectures in the University of Pennsylvania. Here he met Mr. John Esten Cooke, Daniel Drake and William H. Richardson, all of whom were afterwards his colleagues in Transylvania Medical School. At the close of his second session, in 1806, he received the degree of Doctor of Medicine, and returned home to practice. While in practice he engaged in business, but to what extent is not known. In 1810, he decided to go abroad, where he could study medicine and surgery under the great teachers of his day. Sometime during the year he went to New Orleans on a flat-boat. Here he bought a cargo of flour, with which he sailed to Europe. He sold his flour at Gibraltar and Lisbon and went to Paris. During his four years' sojourn abroad, he spent most of his time in Paris and Loudou, where he took advantage of the opportunities for studying anatomy and surgery. He was one of the leaders in the reorganization of the Transylvania Medical School and taught anatomy and surgery until 1844. From this date, until his retirement in 1850, he was Professor of the Principles and Practice of Surgery.

As an operator he was more cautious than bold, and believed that the preparation of the patient for an operation was essential to its success. He performed lithotomy about two hundred and twenty-five times and operated one hundred times before losing a patient. He operated on all but ten cases brought to him, and lost, in all, five cases. In his practice "a puke and purge, a puke and a puke, were used alike in tuberculous diseases, affections of the hip-joint, spine," etc.

His publications were few and of a practical nature. In his first article he asserted that epilepsy was often caused by pressure on the brain, and could often be relieved by trephining.

After he gave up teaching and practicing, in 1850, he passed the remainder of his life in retirement, and died on June 30, 1870, in his eighty-fifth year.

\* Benjamin W. Dudley (1785-1870) was born April 12, 1785, in Spotsylvania County, Virginia. In the following year his parents



Presidency of the University to distinguished men; but each had declined the position. The Trustees seeing the bad condition of the University and having lost the confidence of the people, were convinced that political and religious contention must cease and a concerted action be inaugurated. As a result, Dr. Holly, of Boston, was, in 1817, elected President; which position he accepted on June 25th, 1818.

Dr. Holly was a man of unusual ability; his gentle and pleasing manners, his power as a teacher and a speaker, and his high moral character united with his untiring energy were in no small degree responsible for the subsequent success of the University. He entered upon his duties November 17th, 1818.

In the reorganization of the Medical School, Dr. Holly, although not a Doctor of Medicine, took an active part. Through his influence, combined with that of Drs. Dudley and Caldwell, the Medical School soon occupied a prominent position in the University.

Financial embarrassments were removed to some extent by the sale of the public lands donated by the General Assembly of Virginia and by the gifts of private citizens. The libraries were extended, the laboratories enlarged and better equipped, and more spacious lecture-rooms secured. A museum containing pathological specimens, models for anatomy, surgery and obstetrics, was established. Abundant material for anatomy and operative surgery was also supplied.

The following Chairs were represented in the faculty: Dr. Charles Caldwell,\* Dean of the Faculty and Professor of the

\*Charles Caldwell (1772-1853) was born in Caswell county, N. C., in 1772. When fourteen he had mastered the Ancient Languages and in the following year took charge of the Snow Creek Seminary. In 1792 he entered the University of Pennsylvania, where he soon gained a reputation as a student. His translation of Blumenbach, in 1795, was the beginning of his literary career. In 1803 he instituted the first clinical lectures in the Philadelphia Alms House, now Blockly Hospital, and was appointed Professor of Geology and Natural History in the University of Pennsylvania, in 1816. In Philadelphia his eloquence gained for him great popularity both as a public speaker and as a teacher. Dr. Caldwell was called to Transylvania, in 1818, to occupy the Chair of the Institutes of Medicine and Materia Medica, and in 1837 he founded the University of Louisville, in which he taught until 1849, when the Board of Trustees asked for his resignation. Later he was occupied in establishing the University of Nashville, which soon became a rival of the University of Louisville.

He was much given to controversy, and his discussion with his teacher, Dr. Rush, shows his antagonistic character. While suffering from a high fever, he had been caught in a drenching rain, from which he expected to die; but to his great surprise he found that his fever soon left him. He immediately reported the fact to Dr. Rush. In his lectures Dr. Rush referred to the incident without giving Caldwell due credit. This aroused Caldwell's indignation to such an extent that he openly assailed Dr. Rush at the commencement exercises of the University of Pennsylvania. The mutual friendship which had previously existed, was now broken and Dr. Rush refused to sign Caldwell's diploma. Referring to the discussion, in his autobiography, Dr. Caldwell says, "Although victory perched on my brow, it cost me the Chair of Medicine in the University."

He was a great advocate of Phrenology and had the misfortune to outlive his favorite theme. "As a man, he was proud and egotistic; as a student, thorough and diligent; as a writer, clear, and as a physician, seldom consulted." He died in July, 1853, in his eighty-first year.

Institutes of Medicine; Dr. B. W. Dudley, Professor of Anatomy and Surgery; Dr. Samuel Brown, Professor of the Theory and Practice of Medicine; Dr. William H. Richardson, Professor of Obstetrics; Dr. James Blythe, Professor of Chemistry, and Constantine F. Rafinesque, Professor of Medical Botany.

In the reorganization of the Transylvania University, the following is the record of the first Faculty Meeting:

"First Session, 1819-20, Nov. 8th, 1819. The Faculty convened, present—Benjamin W. Dudley, Charles Caldwell, Samuel Brown, William H. Richardson and James Blythe.

"Charles Caldwell, M. D., was unanimously elected Dean, and requested to prepare and deliver, in behalf of the Faculty at the time of their induction into office, an inaugural address.

"Their request was complied with on the 18th of the same month and the address printed at the unanimous request of the Faculty and the Board of Trustees separately expressed.

"[Signed]

C. CALDWELL,  
Dean M. F. T. U.

By W. H. RICHARDSON."

Shortly afterwards we find in the records the following rules to govern the proceedings of the Faculty of Medicine:

"1. Any physician of reputation who shall have been engaged in the practice of his profession for the term of four years, then attended one entire course of lectures in this institution, shall be entitled to present himself as a candidate for the Degree of Doctor of Medicine.

"2. All candidates for said degree must, by the first day of February in every year, signify to the Dean of the Faculty, in writing, their intention to present themselves for examination, specifying at the same time the subject on which they propose to write.

"3. Each candidate, before receiving his diploma, shall satisfactorily sustain an examination before the Medical Faculty alone, and another in the presence of the Trustees and the President of the University. He shall, moreover, write and defend in public (in the chapel of the University or such other place as may be hereafter directed) a dissertation in the Latin, French or English language, pay to the librarian (of the Medical Faculty) the sum of five dollars and the cost of the diploma, which he shall receive. The fee for graduation shall be twenty-five dollars.

"4. Each candidate must be twenty-one years of age, and unless he shall, as above specified, have engaged in practice four years, must have attended two full courses of medical lectures, one of them at least in this University, and the other in some respectable chartered school of medicine, governed by the same laws in granting diplomas with this.

"Thesis must be not less than twelve nor more than forty pages, uniform paper, style and everything considered."

The first session opened with thirty-four students. In the spring of 1820 four students received their degrees, and honorary degrees were conferred upon three. The number of students rapidly increased, reaching in 1826 two hundred and eighty-one. This was the largest number recorded for one session. The number of graduates, however, increased until 1835, when eighty-three degrees were conferred. The total number of students enrolled in the Medical School during the forty years of its existence is four thousand three hundred and fifty-eight; the number of graduates one thousand eight hundred and thirty-three; and forty-four honorary degrees were conferred.

The library of Transylvania University was founded in

1784, by the Rev. John Todd, of Virginia. Soon after the establishment of the Medical Department, in 1799, five hundred dollars were appropriated for the further equipment of the library. After the reorganization of the Medical Department in 1818, the library was greatly enlarged and well provided with the standard books and journals of Europe and America.

In 1821, Dr. Caldwell was sent to Europe by the faculty to purchase new books and publications. For this purpose he took with him five thousand dollars appropriated by the Legislature of Kentucky, and six thousand dollars appropriated by the city of Lexington.

In the *Transylvania Medical Journal* for 1828, we find that the library contained three thousand volumes, comprising all of the rare and standard works of medicine and the associated branches of science, besides many publications of Europe and all of America.

After the reorganization of the faculty in 1837, Dr. Peter was sent to Europe to purchase books, apparatus, etc., and we find the following account rendered on March 25th, 1839: books and plates, six thousand dollars; chemical apparatus, two thousand five hundred dollars; preparations for anatomy and surgery, one thousand five hundred dollars; models for obstetrics, five hundred dollars; specimens for materia medica and therapeutics and drawing, five hundred dollars. A total of eleven thousand dollars.

The number of volumes at present in the library is five thousand six hundred and eighty-four; pamphlets and medical journals, seven hundred and fifty-four; bound volumes of theses, one hundred and thirty-eight.

The library is now owned by the Kentucky University located at Lexington, Kentucky.

In 1823, Dr. Daniel Drake,\* of Cincinnati, was appointed

\* Daniel Drake (1785-1852) was born at Plainfield, Essex county, New Jersey, October 20th, 1785. His only inheritance was industry, temperance and piety. In early life he attended school during the winter months, generally from November to March, and the remaining part of the year worked on his father's farm.

Young Drake in his sixteenth year was sent to Cincinnati to study medicine under Dr. Goforth. He was to study medicine four years and Latin two quarters. His first duties under Dr. Goforth were to read Quincy's Dispensatory and grind quicksilver into mercurial ointment; the latter of which he found, from previous practice on a Kentucky hand-mill, much the easier of the two. At the close of his studies, he formed a partnership with his preceptor; and in 1805 attended his first course of lectures in the University of Pennsylvania.

In 1815 he attended his second course of lectures in the University of Pennsylvania and was graduated in the following spring, receiving many compliments from the faculty.

He returned to Cincinnati in 1816, and immediately acquired a profitable practice. During the year he was called to the Chair of Materia Medica in the *Transylvania Medical School*; and in the following year returned to Cincinnati to resume his practice.

In 1819 he founded, at Cincinnati, the Medical College of Ohio, in which he was Professor of Medicine. In the following year he was expelled from the faculty, he himself being the presiding officer on the occasion of his expulsion.

He again occupied the Chair of Materia Medica in the *Transylvania University* in the autumn of 1823; and in 1825 was transferred

to the Chair of Materia Medica and Medical Botany. On the resignation of Dr. Brown in 1825, Dr. Drake was transferred to the Chair of the Theory and Practice of Medicine, which position he resigned in 1827. Dr. Short was appointed to the vacant Chair of Materia Medica and Botany in 1825, and Dr. Cooke to that of the Theory and Practice of Medicine in 1827.

The following extract is taken from the minutes of a faculty meeting, on February 27th, 1826: "On motion it was resolved to examine six candidates daily, four in the forenoon, beginning at ten o'clock, and two at night, beginning at seven o'clock." All the Professors were present. Examinations were held on Monday, Tuesday, Wednesday, Thursday, Friday and Saturday. An examination was held before the Board of Trustees, March 11th, 1826, beginning at nine o'clock, and concluding at noon. The commencement exercises were held at three o'clock of the same day.

The resignation of Dr. Holly, in 1826, which was brought about by religious contention and the publication of anonymous letters, was a heavy blow to the Academical Department of *Transylvania*. This department soon sank into insignificance and excepting a few successful sessions in the forties, was never restored to its former position. The Medical Department was now secure, and the subsequent reputation of *Transylvania* was largely due to this department.

The following are abstracts from the minutes of the faculty meetings:

"REGULATIONS FOR THE DISSECTING ROOM.—The Demonstrator of Anatomy shall be chosen by the Faculty and shall furnish all the material, keep order, clean the room, preserve morbid growths and keep the dissecting room open from six to ten P. M."

"Whereas it has come to the knowledge of the Faculty that John Mason Marble of Tenn., a graduate of the last Medical Commencement, did copy the thesis of a former graduate and present it as his own production, which was received as such by the Faculty, therefore, be it resolved, that the said J. M. Marble be requested to attend another full course of lectures at the coming session and present another thesis of his own composition to the examination of the Faculty, and that the Dean be instructed to transmit a copy of this resolution with the determination of the Faculty in case it is not complied with, to the said Marble."

to the Chair of Medicine, which position he held for two years. In 1830, he was called to the Chair of Medicine in Jefferson College, of Philadelphia, where his eloquence and winning and attractive manners soon gained for him great popularity.

The Medical Department of the Cincinnati College was organized by him in 1835. He became Professor of Medicine, and Dr. S. D. Gross Professor of Pathological Anatomy. He was called to the Chair of Clinical Medicine and Pathological Anatomy in the University of Louisville in 1840, and in 1844 was transferred to the Chair of Medicine, which position he resigned in 1849. During the following year he was Professor of Medicine in the Medical College of Ohio; and in 1850 he was again called to Louisville. Two years later he returned to the Medical College of Ohio, but near the beginning of the session, on November 6th, 1852, death ended his varied and useful career.

As a writer he was interesting, clear and forceful; and was for many years editor of the *Western Journal of Medicine and Surgery*. During the later years of his life, he wrote a most interesting volume on "The Principal Diseases of the Interior Valley of North America," which was largely the result of his own observations and experience.



Dr. Blythe, in 1830, resigned the Chair of Chemistry and Dr. Lunsford P. Yandell was in the following year appointed to fill the vacancy, with Mr. H. Hubert Eaton, A. M., as his assistant.

In 1835 a summer school was established on the same basis as the winter session. Nine students were enrolled the first year, and sixteen was the largest number during any one year. The summer school was discontinued in 1840 and again reorganized in 1846.

Previous to 1837, the faculty had, on several occasions, discussed the advisability of moving the Medical Department of Transylvania to a larger city. The feelings of the several members of the faculty were not generally known until 1837, when Dr. Caldwell received an invitation from Hon. James Guthrie, of Louisville, Ky., to establish a Medical School in that city. It was first proposed to move the Medical Department of Transylvania to Louisville, but the proposition was soon given up on account of the manifest indignation of the citizens of Lexington and of some members of the faculty. The invitation was accepted by Dr. Caldwell and through his influence Drs. Short, Yandell and Cooke moved to Louisville.

The Faculty of the Medical Department of Transylvania was at once reorganized and consisted of the following members: Dr. B. W. Dudley, Professor of Anatomy and Surgery; Dr. J. M. Bush, Adjunct Professor of Anatomy and Surgery; Dr. James C. Cross, Professor of the Institutes of Medicine and Medical Jurisprudence; Dr. John Eberle, Professor of the Theory and Practice of Medicine; Dr. William H. Richardson, Professor of Obstetrics and the Diseases of Women; Dr. Thomas D. Mitchell, Professor of Materia Medica and Therapeutics, and Dr. Robert Peter, Professor of Chemistry and Pharmacy.

Public interest was awakened and an effort was made to increase the endowment of the Medical Department. In 1838-39, the city of Lexington donated seventy thousand dollars, and a private subscription amounting to thirty-five thousand dollars was given to the Department. The subscription from the professors materially aided in the erection of the new medical hall on the northwest corner of Broadway and Second Streets. The laboratories, libraries and museum were better equipped and the means of instruction greatly improved. The new medical hall was very complete and convenient.

The Chair of the Theory and Practice of Medicine which had been made vacant in 1838 by the death of Dr. Eberle was filled by the election of Dr. Nathan R. Smith,\* of Baltimore.

\*Nathan R. Smith (1797-1877) was born at Cornish, N. H., May 21st, 1797. At the age of twenty he graduated from Yale, and during the following eighteen months was a tutor in the house of Thomas Turner, of Virginia. At the expiration of this time he returned North and graduated from the Yale Medical School in 1823, taking for his thesis "The Pathological Relations of the Blood."

The following year he began the practice of medicine, in Birmingham, Vermont, and in 1825 was appointed Professor of Surgery and Anatomy in the University of Vermont.

In 1825-26 Dr. Smith visited Philadelphia, where he met Dr. McClellan and others, who were at that time organizing the Jefferson Medical School. Dr. McClellan was favorably impressed with Dr. Smith's professional knowledge and invited him to join their

project and occupy the Chair of Anatomy. According to request, Dr. Smith accepted, holding his position two years.

In 1827 he was called to the Chair of Anatomy in the University of Maryland, and in 1829 was transferred to the Chair of Surgery.

On invitation from the Medical Faculty of Transylvania University, Dr. Smith in 1838, accepted the Chair of the Theory and Practice of Medicine made vacant by the death of Dr. Eberle. He held this position three years, when the following letter of resignation was sent to the Dean of the Faculty:

January 7th, 1841.

To R. Peter, Dean of the Medical Faculty of Transylvania University.

My Dear Sir:—It is obviously due to the Faculty of the Medical Department of Transylvania University, whom I have the honor to address through you, that any decision which I may have made in regard to further connection with that department should be announced as soon as made.

I regret to state that circumstances of an imperative nature, and some of them not anticipated, will compel me to resign my chair at the end of the present session. These circumstances are chiefly of a pecuniary character, and cannot but exercise a coercive influence upon one surrounded, as I am, by a young and numerous family, and with my mother's family, at New Haven, consisting of several members, entirely dependent on my exertions.

An unexpected claim, resulting from the delinquency of former Trustees of the University of Maryland, amounting to three thousand dollars, is urged against me. I have no feasible mode of release but by connection with the University of Maryland. It is unnecessary that I should explain particulars.

My residence in Lexington during three winters has satisfied me that practice, having any comparison with that which I enjoy in Baltimore, is not by any one to be hastily obtained here, preoccupied as the field isand limited in extent. The emoluments of my chair, deducting the current expenses of the institution, loss on uncurrent money, etc., would by no means be adequate to my wants, and to continue my connection on otherwise than on equal terms with my associates, I should neither desire nor consent to. Indeed, it has been a source of pain to me that circumstances have compelled me to accept thus far the extra considerations named in our contract and always so punctually tendered by you.

Permit me to say that I should not originally have accepted the Chair of Practice on any terms, had there not been some possibility that I should become a permanent occupant of it. I am left, however, free to decide at this time and I am now influenced in my decision chiefly by contingencies which I could not have foreseen.

I assure the Faculty that I am fully sensible that our contract has been an unprofitable one on either part, but I trust they will do me the justice to bear in mind that both last year and the year before, I signified in a letter to one of their body, my willingness to withdraw at any moment that they might be able to make more permanent and satisfactory arrangements.

It will be seen that the circumstances which determine my resignation do not at all involve my personal relations nor my confidence in the stability and future prosperity of the institution. Never have I been connected with an association with whom (sic) it could be more agreeable to co-operate. To every member of the Faculty I am incalculably indebted for the flattering estimate which placed me in the chair, and has maintained me in it. The necessity which dissolves my connection with this body will be remembered as one of the most painful of my life, whilst the agreeable intercourse which I have enjoyed with its members and the honor of having occupied a Chair in Transylvania will ever be remembered with the most gratifying associations.

By the influence of the reputation and efficient exertions of the present Faculty and by the munificence of the citizens of Lexington, the Medical Department of Transylvania is now placed upon a foundation which renders its position perfectly secure. Its friends may, without fear of contradiction, pronounce it to be decidedly the best-endowed Medical School in America. Its patronage and the emoluments of its Chairs are second to those of but one, and there are none, to be associated with which, I should consider it a higher honor.

Under these circumstances my resignation cannot exercise the least injurious influence upon its prosperity. The chair will immediately command the service of some one whose labors will be more efficient than mine.

You will please, dear Sir, convey to the members of the Faculty assurance of my great respect and affectionate consideration. Yours most truly,

N. R. SMITH.

#### LETTER TO DR. SMITH FROM THE FACULTY.

Dear Sir:—Receipt of your communication informing us that circumstances beyond your control would oblige you to resign the Chair of the Theory and Practice of Medicine in the Medical Department of Transylvania University at the end of the present session, renders some expression of sentiment on our part both just and appropriate.

Permit us, therefore, to assure you that we receive the information of your intended resignation with regret and that nothing would have afforded us more gratification than the certainty of your continuance among us as a fellow-citizen and colleague.

The intercourse which has existed between us for three years during which



Dr. Elisha Bartlett\* was elected to fill the Chair of the Theory and Practice of Medicine vacated by the resignation of Dr. Smith. This position he held until 1844, when he also resigned.

The attendance at the Medical School was gradually diminishing, so another attempt was made to place the Medical Department on a better footing. In 1844 the faculty was fully reorganized and the schedule revised. The following subjects were included in the schedule: Materia Medica and Therapeutics, Obstetrics, Chemistry, Anatomy, Surgery, General and Pathological Anatomy and the Theory and Practice of Medicine.

Dr. Lawson, of Cincinnati, Ohio, was called to the Chair of General and Pathological Anatomy and Physiology. Dr. Dudley occupied the Chair of the Principles and Practice of Surgery, and Dr. Bush that of Special and Surgical Anatomy. Four thousand circulars announcing the new reorganization were ordered at Cincinnati.

Dr. L. G. Wilson, of North Carolina, was chosen to fill the chair vacated by Dr. Bartlett.

In 1846 the faculty called for the resignation of Dr. Wilson and the chair was offered to Dr. Bartlett. The death of Dr. Richardson, in 1846, made vacant the Chair of Obstetrics, which was afterwards occupied by Dr. Annan. In 1849, Dr. Annan was transferred to the Chair of the Theory and Practice of Medicine, and Dr. W. M. Bolling, of Montgomery, Ala., was appointed to the Chair of Obstetrics. In 1847 Dr. E. L. Dudley was elected to the chair previously held by Dr. Lawson, and in 1848 Dr. H. M. Skillman was appointed Demonstrator of Anatomy.

The records of the subsequent history of the Medical Department have been either lost or destroyed, excepting the matriculation book, which shows that the number of students

we have been associated, has been of the most harmonious and pleasant character, and the ability with which you have performed the duties of your Chair increase the reluctance with which we give up the expectations of a longer co-operation with you under the auspices of the Transylvania University.

With the most sincere wishes for your continued increase in fame and prosperity, we remain your friends and colleagues.

THE MEDICAL FACULTY OF TRANSYLVANIA UNIVERSITY,  
ROBERT PETER, Dean.

gradually decreased from year to year until 1858, when twenty-three students were enrolled. This was the last session.

During the Civil War the Medical Hall was used by the Union forces as a hospital and stable. It was later destroyed by fire. The libraries and apparatus were removed to Morrison Chapel which now belongs to the Kentucky University.

On returning to Baltimore Dr. Smith occupied the Chair of Surgery, in the University of Maryland, until 1870, when he retired.

As a surgeon, he was famous; as a citizen, philanthropic and beloved.

His chief works were: "The Surgical Anatomy of the Arteries;" "Fractures of the Lower Extremity." He invented an anterior splint to be used in fractures of the lower extremity, and a lithotome.

His death occurred July 3, 1877.

\* Elisha Bartlett (1804-1855), was born at Smithfield, Rhode Island, October 6, 1804. His early education was received from the best seminaries in the places where he occasionally resided. His professional education was of the same varied nature. Having studied at Uxbridge, Worcester, Burton, Providence, he received his degree from Brown University in 1826. "His varied education made him familiar with, and attractive in, all social circles, easy and graceful in his manners, and universally popular."

After graduating he repaired to Paris for the further study of medicine. Leaving Paris after a year's profitable study, he journeyed into Italy before returning to America.

His first residence in America, as a physician, was at Lowell, Mass., where he soon enjoyed a lucrative practice. He married in Lowell in 1827, and in 1828 accepted the Chair of Anatomy in the recently established school at Woodstock, Vermont.

He was appointed Professor of Pathological Anatomy in the Berkshire Institute at Pittsfield, Massachusetts, in 1832, and in 1844 the University of Maryland offered to him the Chair of the Theory and Practice of Medicine. In 1850 he occupied the Chair of the Institutes of Medicine in the University of the City of New York, and on the death of Dr. Beck was called, in 1851, as Professor of Materia Medica and Medical Jurisprudence, to the College of Physicians and Surgeons of New York. Owing to his failing health he soon gave up his professorship and retired to Smithfield, Rhode Island, where he died in 1855.

He was, in 1836, chosen the first mayor of Lowell, and, in 1840, was sent as representative to the Legislature of the State of Massachusetts. As a writer, he was clear and interesting; as a speaker, eloquent and attractive.

## SKETCH OF JOHN CRAWFORD, M. D.\*

By E. F. CORDELL, M. D.

(Read before the Johns Hopkins Historical Club, May, 1899.)

Although now quite forgotten by the profession of this city and State, there is no name in all its annals more honorable or worthy of perpetuation than that of Dr. John

\* Dr. Quinan, *Med. Annals, sub voce*, has placed a "Rev." after Dr. Crawford's name. The deep religious fervor of the latter, so unusual in a medical writer, may have suggested the idea that he was a clergyman; or, Dr. Quinan may have confounded with him a "Rev. John Crawford," who resided in Baltimore at one time and some of whose writings are extant. There is no justification for the clerical title.

Crawford, of Baltimore. His life, character and writings afford abundant material for a biographical sketch of the deepest interest. He was the second son of a clergyman in the north of Ireland, where he was born May 3, 1746. His family was highly respectable but poor. His father was a scholar, a man of talent and piety, who raised his children in the love and fear of God. The seeds thus sown brought forth a rich harvest of virtues in the son, the subject of this memoir. His brother, Adair, achieved eminence in England and is spoken of as "one of the most

brilliant ornaments of medicine and philosophy" in that country.† John was reared among his family until the age of 17, when he was sent to Trinity College, Dublin, to pursue classical studies. Thence he went to the University of Leyden, which was then in high repute, owing chiefly to the great fame of Boerhaave, and there he received the degree of Doctor of Medicine. He then made two voyages to the East Indies as surgeon in the East India Company's service, receiving on his return the thanks of the Company and a considerable sum of money for his zeal and fidelity. During these voyages he kept a diary, from which very interesting extracts were published in the Edinburgh "*Annals of Medicine*." About the year 1778 he was married, and shortly after received the appointment of Physician-in-Chief to the Hospital in the Island of Barbadoes. This was a position of great honor, and it might also, in other hands, have proven an avenue to great wealth, for Dr. Crawford had under his control large contracts for supplying the British fleets on the West India station. But with that magnanimity and self-neglect which so often characterize men of lofty character and purpose, he cared but little for wealth and allowed opportunities for acquiring fortune to go, without even a share of their profits, to others. In the year 1780 the island was devastated by a terrible hurricane, and this afforded occasion for the exhibition of his generous and humane disposition. Amidst general ruin his property alone remained intact, and not a single medicine was left upon the island except what was in his possession. He refused to profit by the common distress, but supplied medicines and other aid to those who needed them without stint and without compensation. In 1782 bad health compelled him to return to England. During this voyage his wife died under very distressing circumstances, leaving to him the care of two infant children. Having recovered his health he returned to Barbadoes, but soon after removed to Demerara, where he had been appointed Surgeon-Major to that colony then in the possession of the Dutch. During his residence at Demerara the authorities conferred high honors on him, and he had frequent opportunities for the exhibition of that philanthropy which was his peculiar attribute. His house, his table and his purse were open at all times and to all. Strangers especially profited by his open-handed hospitality. But he did not neglect professional duties and interests. The military hospital with 60 to 80 beds, and absolutely under his control, afforded a wide field for observation and study, and he made a large number of autopsies. An observation which he made at this time was the frequency with which he found abscess in the liver where there had been no symptoms pointing to its existence during life. About the end of 1794 his

health again gave way under the influence of bad climate, and he was obliged to return to England. Thence he went over to Holland to settle business affairs with the Dutch government. During his stay in Holland most of his time was spent at Leyden in study and research. Meanwhile Demerara was transferred to the control of the English. Although he was offered by the English government the same position which he had recently held in the colony, in the interest of his children whom he desired to be well educated, and by the solicitations of a brother-in-law who had already crossed the water, he was induced to decline the offer and embark for the United States. He arrived in Baltimore in 1796, the year the city charter was granted, and about the same time Drs. Davidge and Potter settled here. Thenceforth, for seventeen years, Baltimore was the scene of his mature life-work. A man of such a character and acquisitions could not long remain obscure in any community. "The unaffected urbanity of his address and manners," says his biographer, "the sweet benevolence of soul, the innate dignity of mind which shone with such animated luster in every lineament of his noble, manly countenance, soon gained him the acquaintance and esteem of all whose respect is valuable of every class of his fellow citizens." A professional career would furnish such a generous nature many opportunities for the exhibition of a humane and unselfish conduct, but such acts form but the ordinary routine of a good physician's life and their existence is only known by their being the necessary accompaniments of such a life. Of Dr. Crawford's public acts we know more. He was a participator, if not a leader, in most of the humanitarian enterprises of his day. The Baltimore General Dispensary, established in 1801, owes its origin directly to him, and he continued an active manager of it until his death. He was also connected with the Hibernian Benevolent Society from the earliest period of its existence and held several offices in it. To his indefatigable exertions, perhaps, more than to those of any other individual, is the State indebted for the establishment of the Penitentiary. He was one of the founders of the Bible Society of Baltimore, an association of Christians of every denomination, designed to promote the spread of the gospel among all men.\* He was also one of the directors of the "Baltimore Library," the first institution of the sort in the city. There is extant a lecture delivered by him at the Medical College, in November, 1811; it is entitled, "*Introductory to a Course of Lectures on the Cause, Seat and Cure of Diseases*," 8vo., pp. 51. In November, 1812, he began another course on Natural History, on Hanover street, continued later on Commerce street. This course was also under the auspices of the college, and was to have been given at the college on Lombard street, but the building was not sufficiently advanced at the time for occupation. The title of the chair which he held from the Regents of the college was "Lecturer on Natural History." He was soon compelled to abandon this course, but the reasons for its discontinuance are not given. Of the lectures which he gave his biographer says: "His compositions were remarkable for

† I find the following notice of Dr. Adair Crawford, in the *Cyclopedia of Biography*, by Parke Godwin, N. Y., 1880: "Physician and Naturalist. Physician to St. Thomas' Hospital and Professor of Chemistry at Woolwich. Author of several chemical works." In his lecture on "The Cause, Seat and Cure of Disease," Dr. John Crawford refers to his brother as "my revered brother . . . who was the first to ascertain by actual experiment that animal heat was derived from the air in respiration, and thus brought to a conclusion the conflicting opinions on that intricate subject."

\* He was a director of the "Maryland Society for Promoting Useful Knowledge," founded in 1800.



correct and elegant style, and . . . displayed a soundness of erudition and a depth of research seldom equaled." Dr. Crawford's professional standing and enterprise are also shown by the part he took in the introduction of vaccination in this country. He received a supply of virus from Dr. Ring of London, in the summer of 1800, and was successful in its use.\* This was contemporaneous with its use in Cambridge, Massachusetts, by Dr. Waterhouse, to whom the credit is usually given of having been the first to employ it in America.

With such sentiments and such a desire to be useful to his fellow-men, it is not surprising that he drifted into an organization which holds charity to be a supreme virtue and duty. He became connected with the Masonic Order here in 1798. In this he had a wider field for the exercise of that benevolence which was a part and a very necessity of his nature. He rose at once to the highest office in his Lodge and was recognized as a leader among his brethren in the State. In 1801 he became Grand Master, having already presided at most of the meetings of the Grand Lodge during the previous two years. After this he was continuously and unanimously elected to the same office, with the exception of one year when his professional engagements compelled him to decline, to the period of his death in 1813. The charges which he delivered to his brethren in the Grand Lodge have been preserved and they are models of style and of Christian fervor. So highly esteemed were they by the fraternity that in order to diffuse their beneficial influence more widely they were in some instances published and distributed among the order in other States. His numerous Masonic writings, including a work upon Masonry, which he had prepared for publication, were bequeathed by his will to his "beloved friend Nicholas Le Favre, Esq., of Philadelphia, Gentleman." He also wrote many medical articles which are highly interesting and valuable. He was a large contributor to the "Medical and Physical Recorder," 1808-9, edited by Dr. Tobias Watkins, the first medical journal published in Maryland. His medical writings were bequeathed to Dr. William Donaldson, of Baltimore, and have probably been destroyed. Although—and it seems strange—Dr. Crawford did not enjoy the honor of being an incorporator or founder of the Medical and Surgical Faculty of Maryland, he held high rank in its early councils, being censor, examiner, orator, and member of the committee appointed to publish its transactions. He was also Chairman of "The Medical Faculty of Baltimore" and as such made a report on the health of the city to the City Council, February 10, 1800. He was Vice-president of the Medical Society of Baltimore and Consulting Physician to the Board of Health and City Hospital. Doctor Crawford died at his residence, corner of Hanover and German Streets, on the morning of the 9th of May, 1813. Of the nature of his illness we are not informed, but it was brief and violent in character. The Grand Lodge was then in session. He attended the meeting on May 4, and delivered an annual address as usual. It is said to have been able and excellent—"the production of his rich imagination, couched in the most affectionate and parental language." At its conclusion he

intimated to his brethren his wish to retire from office and pleaded in excuse for not serving longer his already lengthy services and advanced age. He then withdrew, giving the Tyler an affectionate shake of the hand as he passed through the adjoining room, and remarking that the door which had just closed upon him would never again be opened for his reception. Hardly had he left the lodge room before the members, by spontaneous act, gave him a unanimous vote of continuance. His presentiment came true. Owing to the apprehension consequent upon the approach of the British, the Grand Lodge did not meet again until the 9th of the month. Meanwhile, on the very next day after his attendance, he was attacked with the fatal illness which terminated his life in less than four days. On the 10th of May the Grand Lodge was convened and followed his remains in sad procession to the Presbyterian graveyard, corner Fayette and Greene Streets, where they were duly interred. In the following June a monument of sandstone and marble, carved with masonic emblems and containing an inscription conveying the chief facts here stated, was erected in his honor.

Dr. Crawford left one child, a daughter, who married Mr. Maximilian Godefroy, an architect and the designer of many of the public buildings of this city. It is not known whether she had any children. Dr. Crawford's library was purchased from his widow by the Regents of the University of Maryland and formed the nucleus of the library of that institution now known, from the larger bequest of another physician, as the "Brune Collection."

The character of Dr. Crawford seems to have excited the admiration and reverence of every one who came in contact with him. His urbanity, his unselfishness, his tireless charity, his forgetfulness of injury, his genuine human sympathy, his earnest Christian piety and his social virtues, made him a model for imitation. His scientific and professional attainments and position were conspicuous and freely acknowledged. His time, his labors, his cares and his fortune were devoted to the cause of suffering humanity. One writer says of him: "Since the days of the celebrated Howard that man has not appeared on the stage of life whose character so nearly resembled that celebrated philanthropist as Dr. Crawford." Many remarked his strong resemblance in face and form to Washington. Nor did this resemblance, which appears in his picture, stop at the exterior; there was also a close identity of sentiment, motive and character. There can be little doubt that upon a larger field of action, Dr. Crawford would have proven with equal certainty that he possessed the same elements of greatness; for greatness is not insured by the mere possession of certain qualities of mind and heart but requires an opportunity also for its exhibition.

Dr. Quinan (Medical Annals of Baltimore. 8vo. Baltimore, 1884) gives the following list of writings of Dr. Crawford:

Thesis (title unknown); Journal of a Voyage to Bombay and Bengal as Surgeon in the Employ of the East India Company. 1772; Observations on Native Camphor, Medical Communications. Edinburgh. Vol. 8, p. 253, 1793; On a Disease of the Liver hitherto little known. London. 8vo., 1776 (?); Report,

\* *Ring on Cow-pox*, 1801, p. 496. (quoted by Quinan).



as Chairman of Medical Faculty of Baltimore, to City Council on Health of the City, February 10, 1800; Address at Grand Convention of Free Masons of the State of Maryland. Dobbin & Co., Baltimore, 1802. 8vo., pp. 48; On the Sanicula. Baltimore Medical and Physical Recorder, Vol. 1, 1809; Hepatic Cases, Same, 1809; Case of Ascites, Same, 1809; On Seats and Causes of Disease, Same, 1809; A Lecture Introductory to a Course of Lectures on the Causes and Seats of Disease, etc. E. J. Coale, Baltimore, 1811. 12mo., pp. 51; Four Letters on the Treatment of Yellow Fever. Federal Gazette, September, 1802. To these I would add: Remarks on Quarantines. Baltimore Observer, Vols. 1 and 2, 1806-7. Dr. Crawford also delivered one of the Biennial Orations before the Medical and Chirurgial Faculty in 1805, but I am not aware that it was published.

Of the above I have had access to the Masonic Addresses, the lecture on the Seat, Cause and Cure of Disease, and the Remarks on Quarantines. Several others can be seen in the "Medical and Physical Recorder," 1808-9, edited by Dr. Tobias Watkins, a copy of which is preserved in the Surgeon-General's Library in Washington. I may say, in passing, that some of the purely literary articles in the Baltimore Observer are doubtless by his pen, and I have a strong suspicion that the lady editor of that periodical was his own daughter.

I direct your attention now to Dr. Crawford's writings as they have come under my notice.

A strongly religious tone pervades his works; it has a genuine ring and is altogether free from cant: "There is one course I shall pursue," he says, "which has been strangely neglected by medical writers—never to lose sight of the Creator."\* Speaking of the infidelity prevalent among the "Faculty," he says that professional study, being directed to the physical causes and operations of the animal economy, tends to a neglect or undue appreciation of the spiritual side of life. Hence, physicians are disposed to attribute to secondary causes things which can only belong to first; and so, resting there, they lose sight of a Divine cause. It cannot be that true religion and true philosophy are ever at variance with each other; on the contrary, when rightly understood they mutually and powerfully support each other. Who but the Deity, he asks, could operate the wonders that are continually pressing upon our regards? Attributed to a divine source, wonder is changed into admiration, reverence and devotion! Philosophy can never be brought to perfection unless the mind of the investigator is suitably impressed with the necessity of having his thoughts continually directed to the stupendous Author of all things. It cannot be too frequently or too strongly urged that our success will be precisely in proportion to our discovery of the designs of Him by whom the objects of our inquiry were contrived and executed.

Passing on to the more strictly medical writings—I refer particularly to those on Quarantine and on "The Cause, Seat and Cure of Disease"—in these he discusses principally the origin of disease, and it is his views upon this subject that especially rivet our attention and constitute, as I think, his title to fame. The lecture on "The Cause, Seat and Cure

of Disease," besides outlining the course which he proposes giving,† deals almost exclusively with the first of the three subjects named and in the more general way of an introductory lecture. It is in the article, or series of articles, on Quarantine that he enters into the details of the subject and produces his facts. I regret to say that the volume containing the latter was not known to me until two days ago and I have had opportunity for only the most cursory examination of it. The volume in which it is contained (Baltimore Observer, a weekly literary publication, commencing November 29, 1806 and continuing until the end of 1807) of which there seems to be in all our libraries but one copy, is the property of the Maryland Historical Society, and the rules of that body do not allow it to be taken out. It is not catalogued and we only knew casually of its existence. Therefore, I am not able to give such a careful analytical review of it as I would wish. I learn, however, that Dr. Crawford first began to entertain the idea of an animated principle, a contagium vivum, as the cause of disease, about 1790, when he went to reside in Demerara, or Guiana. He saw there, of course, a large number of cases of malarial and yellow fever. At the close of the day when the beams of the sun fell aslant upon the earth he saw myriads of minute insects—at other times invisible—fluttering in the air. He said to himself, "if in the air why not in my air tubes? and why not thus the conveyors of disease?"

All analogy taught that disease and decay were coincident with the presence of minute organisms. Such was the case with the putrefying flesh exposed to the air, such with the decaying fruit, such with the rotting wood, such with the moth-eaten garment, the rusted grain. If the fly lays its eggs to develop later into the crawling worm, why may not minute insects deposit their offspring in our bodies, there to develop and ravage the tissues? And he declared that this was a law of universal application, not more applicable to the lower animals than to man, and embracing the vegetable kingdom as well as the animal.‡ With these views he returns to Leyden; and

† "I shall first submit to your consideration a succinct account of the diseases of the human body, the causes of which have been made evident to the senses. . . . I shall then proceed to consider the cause of suffering in the animals that are in nearest connection with us, continue my inquiries through all the animal tribes down to the smallest insect as far as the means of information have been within my reach, and finally advert to the leading sources of destruction in the vegetable kingdom. I shall then revert to man, and hope to reflect the light elicited from them on what is obscure in our own species, etc."

‡ "There is a principle which pervades the whole circle of nature of which we should never lose sight; it is that every individual existing is more or less a type of every other, although no two things whatsoever are exactly alike." Balt. Observer, II, 3, July 18, 1807.

Again: (These animalcule) "do not spare even ourselves. They have been traced through all their various operations and changes on every occasion except the last" (i. e., in man). "Here our progress has been arrested, here our efforts have been palsied. There is not yet an individual, whether naturalist or physician, who has traced diseases to this source or viewed them as constituting a part of the general law of nature. We have seen that in Gaubius, in Boerhaave, and much more in Linnaeus and his followers, there are

\* Cause, Seat and Cure of Diseases.

there, while reviewing some Dutch troops just back from a campaign in the marshes, he enunciates it to Professor Bruggmans, Professor of Natural History and Botany in the University, and another physician who was present. He learns from them to his surprise that such views were not new. Yet there was no mention of them in any of the works on medicine of the day. He mentions a number which were silent on the subject. He continued this line of investigation. He became more and more convinced of the truth of this view. It was with him not a mere hint—a suggestion, a fancy, a possibility or a probability—but an overmastering conviction and the dominating principle of his life, his thought, his conduct. He seems to have realized its predominating importance, that it furnished at once the solution of a problem which had puzzled the greatest minds of the past and led to the greatest variety and absurdity of opinion. More than this, that it furnished a rational method of treatment. Dr. Crawford was a man of learning and genius, and possessed the true scientific spirit. "I shall studiously avoid . . . offering any opinion," he says, "when I have not an ascertained fact to support it." As a comparative pathologist, I doubt if he had a superior. And whilst others had conceived the theory of a contagium vivum, none urged it with the same absolute conviction of its truth, the same mental certainty, the same mastering prevision as he. I think I cannot be wrong in stating this. Certainly he was far ahead of his day in his views—at least seventy or eighty years. What would such a man have accomplished had he been backed by the resources of such an institution as this? He not only held these views as to the cause, but he carried them to their legitimate conclusion as to prevention and treatment. He insisted upon absolute cleanliness and all those things that go to make a perfect hygiene—pure water, pure air, pure food, proper clothing, proper sewerage, and a regulation of the habits of living, but above all and including all, cleanliness. He insisted also that the sick should be removed from, and the well prevented from going to, infected localities, infested in his view with the morbid but invisible agents of disease. In the treatment of disease, likewise, he employed remedies with a view to their destructive effect upon the pathogenic organisms. What is this but antiseptic treatment? Did he not thus anticipate the modern methods of treatment and take the first step that led to the triumphs of Lister? It is true he used the remedies that were in vogue, but he used them upon a different principle and for a different object from those which other physicians had in view. Nor

discoverable many hints to the same effect; but previous to my attempt, I believe I may assert, there is not one who has seriously endeavored to show that there is equally one law by which every animal without any exception is undeviatingly governed."—*The Cause, Seat and Cure of Disease.*

were the results of these investigations to be judged only by our ability at once to control and influence epidemics. "If no other benefit should result from such an investigation, the satisfaction that must be experienced in at all comprehending the nature of what is to be done, and clearly seeing the course that ought to be pursued, will be a blessed exchange for the confusion and doubt which at present exist."

We need not be surprised to learn that he met with opposition, with ridicule, with incredulity. No doubt he was regarded as a "crank" by his medical associates, for every great reformer who has a new truth to teach has such an experience. It is probably for this reason that he sought to inculcate his views through the medium of a lay journal. There is something extremely pathetic in the conclusion of his lecture on "The Cause, Seat and Cure of Disease," 1811. He expects opposition to his view but is prepared for it, has no disquietude as to the result, and would proceed perseveringly with his investigations, hoping to convince those who were not blinded by prejudice against the truth. He was willing to make any sacrifice to attain this object and to submit to any deprivation. "Our ignorance upon this matter cannot continue always," he prophetically declares, "for it is not beyond the limits of human intelligence." Fortunately, he was supported in his purpose by a mind which did not crave luxuries, but was satisfied with the necessities of life; his inclinations were all averse to extravagance and the plainest fare was as acceptable to him as the richest viands. Having already advanced far in his 65th year, the charms of life had largely lost their attractions and there was, therefore, no impediment to his continuing in the path which he had followed for nearly twenty years. "The difficulties I have had to encounter," he concludes, "have indeed increased my ardor. As long as health and life remain, I shall deem myself strictly in the performance of my duty whilst so employed and I shall leave the result to that august Being who has made nothing in vain and who often makes use of the humblest instruments to accomplish his all-wise purposes lest presumptuous man should assume to himself the glory which belongeth alone to God." And so within a brief space passed out of this world this good man, this wise physician; and I venture to think you will agree with me that no one who is engaged in the study of pathology, nay, of medicine itself, can afford to be ignorant of his name and work.\*

The writer desires to acknowledge his indebtedness for much of the biographical part of this sketch to Schultz's "History of Freemasonry in Maryland," Vol. II, 1885.

\*Since this paper was written I have re-read Dr. Crawford's papers in the *Observer*, and find that I have represented him correctly. I shall not, therefore, change what I have written.

## THE JOHNS HOPKINS HOSPITAL BULLETIN.

The Hospital Bulletin contains announcements of courses of lectures, programmes of clinical and pathological study, details of hospital and dispensary practice, abstracts of papers read and other proceedings of the Medical Society of the Hospital, reports of lectures, and other matters of general interest in connection with the work of the Hospital. It is issued monthly.

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# A CASE OF ACUTE SUPPURATIVE CHOLECYSTITIS WITH ISOLATION OF THE BACILLUS TYPHOSUS EIGHTEEN YEARS AFTER AN ATTACK OF TYPHOID FEVER.\*

BY GUY L. HUNTER, M. D., *Assistant Resident Gynecologist The Johns Hopkins Hospital.*

The following case is considered worthy of report, first, because of the great interest shown in recent years in the questions of cholecystitis and cholelithiasis; and second, because of two interesting features in the case itself, viz., the long period elapsing between a probable typhoid infection and the acute cholecystitis; and again, the peculiar morphological and staining properties of the bacillus isolated.

A German woman, aged 54 years, was admitted to the service of Dr. Kelly on February 3, 1899, seeking treatment for a large abdominal tumor. Her family history was unimportant, except that her father had died at the age of 60 with "yellow jaundice." She had given birth to four children, the oldest now being 32 and the youngest 21 years of age. She gave a history of childhood's diseases, and of particular interest was the history of an attack of "remittent fever" eighteen years ago. She was in bed only two weeks, and then insisted upon getting up, although her illness continued for two months. There was typhoid fever in the neighborhood at this time.

She first noticed enlargement of the abdomen three and one-half years ago, after getting up from a serious illness of six weeks' duration. This illness began suddenly as a severe pain in the right side, radiating down into the right inguinal region. The pain became intermittent in character, the attacks lasting one-half hour or more and leaving the patient nauseated and with abdominal tenderness. She had no vomiting and no jaundice, but suffered from several attacks of diarrhoea.

For two years following this illness the patient was well, though suffering occasionally from slight pains and soreness in the right side. She also observed a small movable mass in the right lower quadrant of the abdomen.

Eighteen months before admission to the hospital her attacks of pain increased in frequency and severity, and often after a paroxysm she could not bear the weight of her clothing. Recently she had been confined to bed for short intervals and had lost weight and strength.

Physical examination revealed the presence of a large cyst springing from the left ovarian region. The right ovary was represented by a hard, movable mass, of the size of a fist, lying high in the lower right abdominal quadrant.

For this condition Dr. Kelly operated on February 6, removing both tubes and ovaries with the ovarian cyst. Numerous adhesions to the intestines and omentum were severed or torn apart, and an adherent appendix was removed.

The period of early convalescence was without special interest, the abdominal wound being found healed on the tenth day.

On the fourteenth day the patient complained of nausea and vomited several times during the afternoon and evening.

She had no distension and no particular tenderness. She was more comfortable on the day following, there being no nausea or vomiting. Her temperature reached 100.3° F., and the epigastrium was somewhat sensitive.

At 10 A. M., on the sixteenth day, she suddenly began to complain, as before, of great pain in the epigastrium. Her expression was anxious, and there was profuse perspiration. The temperature was 99° F., and the pulse rate 96. In the epigastrium one could see peristaltic waves from the distended stomach, and at the right costal margin a sensitive tumor which was dull on percussion could be palpated. At 8 P. M. the temperature reached 101° F.

On the seventeenth day her condition became very critical. The pulse rate and temperature, at 4 P. M., were respectively 140 and 103° F. A visible tumor, exquisitely tender, protruded from the costal border in the right hypochondrium, and the gastric distension was even more marked than before. The leucocyte count at 3.30 P. M. was 29,000.

There was some question as to whether we were dealing with a localized abscess, following the removal of the appendix, or with an acute cholecystitis. Her history might well have pointed to repeated gall-stone attacks during the past three and one-half years, although up to and during the operation these attacks of pain had been considered due to localized peritonitides associated with the growing ovarian tumors.

*Operation* (Dr. Stokes).—Cholecystostomy; evacuation of contents of greatly distended gall-bladder; permanent drainage.

An incision over the tumor to the right of the rectus border revealed a greatly distended and congested gall-bladder. Surrounding this were found numerous fresh adhesions and a sero-fibrinous exudate in the peritoneal cavity. No stones were felt on investigation of the bladder and ducts.

After suturing the bladder to the abdominal wall an incision was made allowing the free escape of a large quantity of straw-colored mucoid fluid. Investigation of the deeper portion of the gall-bladder by the fingers was followed by a welling up of a similar quantity of thin, yellow, odorless pus.

The bladder was thoroughly irrigated and permanently drained. No stone was found at the operation, but a calculus of the size of a pea was discharged one week later.

The patient made an uneventful recovery, constantly secreting large quantities of bile until the spontaneous closure of her fistula a month later.

Cultures and glass-slide smears were taken from the peritoneal exudate outside the bladder, and from both the mucoid fluid and the pus within the bladder.

*Bacteriological notes.*—Both culture and smear from the peritoneum were negative for organisms. The smear from the mucoid fluid showed a very few polymorphonuclear and mononuclear cells, and a considerable number of bacilli, varying from short, thick rod-like forms to longer, thinner

\* Read before the Johns Hopkins Medical Society, April 24, 1899.



forms. The smear from the pus showed many pus-cells and a few short, rod-like bacilli. On the agar plates from both the mucoid fluid and the pus was obtained a bacillus in pure culture that corresponded in all its cultural characteristics to the bacillus typhosus. It was actively motile. It decolorized by Gram's method. No gas was formed in glucose-agar. Milk was slightly acidified, reaching its greatest acidity about the second or third day. No indol was formed after one week either in Dunham's solution or in sugar-free bouillon. Flagella, typical of Eberth's bacillus, were demonstrated by Loeffler's method.

*Morphology.*—The morphology of this organism is so unusual that a full report is taken from the bacteriological notes on three of the media for the first two days:

*Twenty-Four Hours:* Plain-slant agar; a short to medium long-rod bacillus, occurring singly, in pairs and short chains; rounded ends; staining deeply and evenly, a few staining lightly in centre.

*Glucose-Agar:* Moderately long bacillus, some plump, some slender; rounded ends; staining very irregularly; some stain deeply full-length, others in the middle only, others on one or both ends, others have nearly lost stain throughout.

*Potato:* Plump medium-long bacillus; rounded ends; staining very irregularly. Many large swollen forms.

*Forty-Eight Hours:* Plain-slant agar; medium long-rod bacillus, mostly staining deeply and evenly; many involution forms, some plump and deeply staining, others long, filamentous and very irregularly staining.

*Glucose-Agar:* An entire loss of normal appearance of the field. The organisms are swollen; only an occasional one takes an even stain, most of them being but shadows or outlines of swollen bacilli. Others stain deeply in centre or on one or both ends.

Many are 4X as long and 2X as thick as normal and show an even faint stain.

*Potato:* Large plump bacilli with square ends, showing a special tendency to take a half-deep stain through middle and leaving both ends unstained. Many large filamentous forms.

Carter,\* two years ago, reported before this society an organism isolated from a patient dead from typhoid fever which showed all the cultural characteristics of the typhoid bacillus but possessed morphological peculiarities similar to those of the organism under discussion. Our bacillus, however, differs from his in showing earlier involution forms, striking changes being observed on agar and potato in 24 hours. On milk, bouillon, and Dunham's solution this organism corresponded morphologically with the control culture of typhoid.

*Widal reaction.*—Testing with the patient's blood and the organism in question, the reaction was positive with the 1:10 and 1:40 dilutions, and unsatisfactory with the 1:100 dilution. With the known typhoid organism the reaction was positive with the 1:100 dilution. With blood from a known typhoid patient in the wards the stock culture of typhoid gave a marked reaction, while the organism in question gave a decided but somewhat less marked reaction in the three dilutions mentioned. Drs. Harris and Schenck very kindly controlled the Widal reactions and were satisfied with the positive character of the results.

\* Report of a case of Polybacterial Infection in Typhoid Fever, with Especial Reference to Certain Involution Exhibited by the Bacillus Typhosus.—The Johns Hopkins Hospital BULLETIN, No. 75, June, 1897.

*Pathogenicity.*—A rabbit was inoculated in the ear vein with 1.2 ccs. of a bouillon emulsion made on a 24-hour blood-serum slant culture. The rabbit died in about 30 hours and the bacillus was recovered in pure culture from the oedematous area at the site of inoculation; and, in the order of the greatest number of colonies, from the following organs: gall bladder, peritoneal cavity, right auricle, spleen, kidneys, urinary bladder, right pleural cavity.

Another rabbit, inoculated with 2 minims of a similar emulsion, was ill for several days but fully recovered.

Cushing,\* in a paper read before this society one year ago, reported 4 cases, collected from the literature, of post-typhoidal cholecystitis associated with gall-stones which had been operated upon and the bacillus typhosus isolated. To these he added 2 cases from the Johns Hopkins Surgical Clinic.

At the same meeting Dr. Miller† reported a case from the Gynecological Clinic. A short time previously Imhofer‡ had reported a case, and recently Mixter§ has added another.

As a result of clinical and experimental observations on this subject Dr. Cushing proposed the following theory regarding gall-stone formation in these cases of typhoidal cholelithiasis—a theory which had similarly occurred to Dr. Mark W. Richardson.

He summarizes as follows: (1) The bacilli during the course of typhoid infection quite constantly invade the gall-bladder; (2) the organisms retain their vitality in this habitat for a long period; (3) in the course of time the bacilli are almost invariably found to be clumped in the bile, suggesting the occurrence of an intravesical agglutinative reaction; (4) the clumps presumably represent nuclei for the deposit of biliary salts, as micro-organisms may with regularity be demonstrated in the centres of recently-formed stones; (5) gall-stones being present in association with the latent, long-lived, infective agents, an inflammatory reaction in the viscus of varying intensity may be provoked at any subsequent period.

A brief survey of some of the theories relating to cholecystitis and cholelithiasis in general may be of interest in connection with this report.

Naunyn,|| in a recent clinical lecture, credits Reidel with holding all cases of cholecystitis dependent upon cholelithiasis; the symptoms, however, of gall-stone colic being due in most, if not in all, cases to the cholecystitis; and, furthermore, this cholecystitis is not an infectious process but follows traumatic irritation by the stone.

\* Typhoidal Cholecystitis and Cholelithiasis. Report of a case without previous history of typhoid fever, and Discussion of a possible Agglutinative Reaction in the Bile and its Relation to Stone Formation.—The Johns Hopkins Hospital BULLETIN, No. 86, May, 1898.

† The presence of the Bacillus Typhosus in the Gall-bladder Seven Years after Typhoid Fever.—The Johns Hopkins Hospital BULLETIN, No. 86, May, 1898.

‡ A Case of Cholecystitis Typhosa. Laparotomie. Heilung.—Prager Medicinische Wochenschrift, 1898. Vol. XXIII, p. 169.

§ A Case of Typhoidal Cholecystitis Associated with Gall-stones; Operation; Recovery.—The Boston Medical Surgical Journal. Vol. CXL., May, 1899, p. 493.

|| Über Cholecystitis und Cholangitis Calculosa. Ztschr. f. prakt. Aerzte; Frank, A. M., 1898, VII, 627.

TABLE I.—Collected cases of post-typhoidal Cholecystitis associated with Gall-Stones which have been operated upon and the bacillus typhosus isolated.

	AUTHOR.	SEX.	AGE.	HISTORY.	OPERATION.	CONTENTS OF GALL-BLADDER.
I.	Gilbert and Girode, Comptes Rendus de la Soc. de Biologie, 1893, p. 95.	F.	45	Gall-bladder symptoms during fever. Subsequent gall-stone attacks.	Operator, Ferrier. Cholecystectomy 5 mos. after fever.	Bac. typhosus, pure. Gall- stone. Purulent fluid.
II.	Dupré (Chantimesses Case), Les infections biliaires. Paris Thèse, 1891.	F.	45	No attack with fever. Subse- quent gall-stone colic.	Cholecystenterostomy 8 mos. after fever.	Bac. typhosus, pure. Gall- stone.
III.	v. Dungen, Münch. Med. Woch., June 29, '97.	F.	46	No attack with fever. Subse- quent cardialgia. Peristitis of lower jaw in 13 yrs. with bac. typh. Acute gall-bladder attack in 14th year. Widal reaction positive.	Operator, Kraske. Cholecystostomy with evacua- tion of abscess 14 yrs. after fever.	Bac. typhosus, pure. No stone found, but probably pres- ent. Abscess.
IV.	M. W. Richardson, Bost. Med. and Surg. Jour., Dec. 2, '97.	F.	50	Recent uncertain history of typhoid. Serum reaction positive.	Operator, M. W. Richardson. Cholecystostomy.	Bac. typhosus, pure. Brownish fluid with bacilli in clumps. Gall-stone in cystic duct.
V.	H. W. Cushing, Johns Hopkins Hosp. Bul., May, 1898.	F.	37	Uncomplicated typhoid 34 mos. ago. Gall-stone colic with jaundice three weeks ago. Recent peritonitis.	Operator, Prof. Halsted. Cholecystostomy.	Empyema of ruptured gall bladder which contained numerous small stones. Bacillus typhosus.
VI.	H. W. Cushing, Johns Hopkins Hosp. Bul., May, 1898.	F.	26	No history of typhoid. Serum reaction positive.	Operator, Prof. Halsted. Cholecystostomy.	Bac. typhosus, pure. Brownish fluid, bacilli in clumps, gall stones.
VII.	Richard Imhofer, Prager Med. Wochenschr., 1898, Vol. XXIII, p. 169.	F.	40	Typhoid fever typical, ending 6 weeks previously. Widal reaction.	Operator, Schloffer. Cholecystostomy.	Pus first, then pure bile, a large hazelnut sized gall-stone. Pure culture. Bac. typhosus.
VIII.	G. Brown Miller, Johns Hopkins Hosp. Bul., 1898, Vol. IX, p. 95.	F.	37	Two attacks of gall-stone colic 7 yrs. ago, followed in 1 mo. by probable attack of typhoid fever. Gall-stone attacks ever since.	Operator, Kelly. Cholecystostomy.	Small amount of bile and milky fluid. Two stones. Pure culture. Bac. typhosus.
IX.	S. J. Mixter, Bost. Med. and Surg. Jour., May 25, 1899.	F.	60	"Dyspepsia" and occasional vomiting of food for 5 yrs. Positive attack of typhoid ending 6 wks. previously.	Operator, Mixter. Cholecystostomy. Choledochostomy.	Turbid bile. 30 gall stones. 2 stones in com. duct. Pure culture. Bac. typhosus.
X.	Writer's Case, Gyn. No. 6682 Feb. 23, 1899.	F.	54	Probable typhoid fever 20 yrs. ago. Widal reaction posi- tive.	Operator, Stokes. Cholecystostomy.	Mucoid clear fluid first, then pus. Stone 1 week later. Bac. typhosus.

Several other post-typhoid cases have been reported without bacteriological notes. These are omitted.

Naunyn calls attention to the fact that all cases of cholecystitis do not have the symptoms of stone. In many other cases diagnosis of gall-stone colic is made *intra vitam*, and abdominal section reveals inflammation of the bladder but no stone in the bladder or passages.

He agrees with Riedel that in many of the so-called gall-stone attacks the symptoms are not caused by wandering of the stones, but by inflammation of the bile passages; but the inflammation is not, as Riedel claims, an aseptic, but a severe infective cholecystitis and cholangitis.

Naunyn calls attention to the chills of cholelithiasis and the spleen and liver tumor that generally accompany the attacks, all of which point to general infection.

Maurice H. Richardson\* reports, from a series of 59 operations upon the gall-bladder, 10 cases in which no history of pre-existing gall-stones or of recent acute infectious disease

could be obtained. He speaks of these cases of sudden onset in persons of apparently perfect health as "acute accidental cholecystitis." In 4 of his 10 cases no gall-stone was found.

Thus, while we know most cases of acute gall-bladder inflammation to be associated with the presence of stones, we must recognize that some are dependent in no way upon this factor.

The experiments of Netter† and of others demonstrate the liability of the bile to infection after aseptic ligature of the common duct. A catarrhal swelling of the ducts and stasis of the bile might similarly lead to infection and cholecystitis.

The etiology of stone-formation has been a hotly contested question for the past 10 years, the war being chiefly waged in France. On the one side are those, headed by Bouchard,‡

† "Présence normale de deux microbes pathogènes, etc." Le Progrès Médical, 1886, p. 992.

‡ Bouchard: "Maladies par ralentissement de la nutrition." Paris, 1882, 6<sup>e</sup> leçon, p. 79.

\* Acute Inflammations of the Gall-bladder. The American Journal of the Medical Sciences, June, 1898.

who still cling to the old idea of a "special diathesis." Others, with Hanot, believe that the calculi probably have a microbic origin, but diathesis is of preponderating influence. At the other extreme are those who claim a microbic origin for gall-stones and support this view by experimental research. Nannyn\* was the first to formulate a theory, holding as probable the infectious origin of biliary lithiasis, and his views have been ably supported in France by such experimenters as Gilbert and his associates, and Mignot.

In this country, Dr. Mark W. Richardson† and Dr. Harvey Cushing‡ have been successful in the experimental production of cholelithiasis.

Mignot,§ after a long series of careful experiments, concludes

Nannyn: "Die Gallenkrankheiten." Congrès de Wiesbaden, 1891.

\* "On the rôle of Bacteria in the Formation of Gall-stones." Jour. Bos. Soc. Med. Sc., Vol. III, No. 4, Jan., 1899.

† Remarks following this paper.

‡ "L'origine microbienne des calculs biliaires." Arch. Generales de Médecine, 1898, Vol. II, p. 129.

that the chief factors in the production of biliary lithiasis are: (1) the presence in the gall-bladder of an attenuated organism, of any variety whatever; (2) a relative inertia of the biliary reservoir causing partial stasis and preventing the premature expulsion of soft concretions of cholesterin.

Gilbert,|| who first reported the experimental production of biliary lithiasis, sounds a warning against the unreserved interpretation of human lithiasis in the same terms. He has recently¶ expressed belief in his ability to cause lithiasis without the intervention of bacteria and by the sole method of a chemical irritation of the vessel walls.

Success in this line, however, would not warrant us in classing human lithiasis as a dyscrasic or toxic process, and we must consider the question sub judice until further investigation throws light upon more of its many problems.

|| Angiocholites et cholecystites typhiques expérimentales. Bull. de la Soc. de biologie, Dec. 23, 1893.

¶ Note pour servir à l'histoire de la théorie microbienne de la lithiase biliaire. Arch. gen. de Méd., Paris, 1898, II, 257.

## OBSERVATIONS UPON THE ORIGIN OF GALL-BLADDER INFECTIONS AND UPON THE EXPERIMENTAL FORMATION OF GALL-STONES.\*

BY HARVEY CUSHING, M. D.,

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Dr. Hunner's report adds one more to the list of cases in which post-typhoidal gall-stone formation and the persistence of Eberth's bacillus in the gall-bladder have combined to set up a suppurative cholecystitis, demanding operative intervention.

There seems to be little doubt at present but that the original source of infection in these cases is a hæmatogenous one, the bacilli first entering the portal circulation through the atrium afforded by the intestinal lesions. As Fütterer<sup>1</sup> has shown experimentally, organisms so introduced are probably for the most part rapidly eliminated by the liver and thus enter the biliary passages, though many may pass into the general circulation, thus producing a temporary peripheral septicæmia. The frequency of such a typhoidal septicæmia has been demonstrated at this hospital by Dr. Gwyn, who has succeeded in cultivating typhoid bacilli from the blood of eight out of thirty patients examined for this purpose in Dr. Osler's clinic and the occurrence in a variety of situations of peripheral suppurative lesions for which the specific organism of the disease is responsible is thus readily explained.

The belief is quite universal, however, that the biliary infection comes about by ascension and that the organisms enter from the intestine into the common duct. Thus Gilbert,<sup>2</sup> in 1894, held that *B. coli* played the most important rôle in cholecystitis because it was found by him in the duodenum in numbers exceeding all other species and because it was possessed

of motile properties which enabled it to enter the common duct. More recently Richardson is quoted by Keen<sup>3</sup> as also expressing a belief in the ascending or intestinal source of infection of the biliary apparatus. He found on one occasion at autopsy "pure cultures of the typhoid bacillus in the gall-bladder, duodenum and jejunum, and it was only when the ileum was reached that colon bacilli began to appear at all." Were the infection an ascending one, I am inclined to believe that other intestinal bacteria from the ileum would have been found associated with the bacillus typhosus in this case.

Recent investigations (unpublished) upon the flora of this part of the intestinal tract have demonstrated, in agreement with the observations of Gilbert and Dominici,<sup>4</sup> that the duodenum, especially of rabbits, is very free from micro-organisms. On one occasion a cubic centimeter of a 24-hour bouillon culture of *B. typhosus* was injected into the ear vein of a rabbit. Two days later from the gall-bladder and duodenum pure cultures of the organism were recovered—a result similar to Richardson's but resultant of course to a hæmatogenous infection. I was not, however, always so fortunate in recovering the organisms. In *Rabbit IX*, which case I will mention later, two days after a similar inoculation into the ear vein, the organisms were not recovered from the bile and in all probability they had been entirely eliminated. I have seen a similar rapid disappearance on direct inoculation into the gall-bladder in dogs. In one animal the bile was sterile twenty-four hours after the inoculation.

Bile itself, contrary to the wide-spread belief in its anti-

\* Remarks before the Johns Hopkins Medical Society to accompany Dr. Hunner's report of a case of Typhoidal Cholecystitis.



septic properties, is a favorable culture medium for most organisms and it is surprising that normal bile should ordinarily be sterile, as Gilbert has demonstrated, when we consider that micro-organisms are in all probability frequently being passed out with it through the liver.

Leubuscher<sup>4</sup> believes that the sterility rests on an unhindered outflow, some degree of obstruction being requisite for the persistence of micro-organisms.

Lettienne<sup>5</sup> showed that bacteria are more likely to be present when there is no disease of the gall-bladder itself, in association with abnormal conditions of the body. In forty-two cases examined he found *Staphylococcus albus* 13 times, *B. coli communis* 13 times, non-liquefying *Staphylococcus* 3 times, *Staph. pyogenes citreus, aureus*, etc., 1 each, *B. typhosus*, *Pneumococcus*, etc., 1 each. On seven occasions the bile was mono-microbic, on 17 poly-microbic, and on 18 sterile. These observations merely show what a highway for micro-organisms the biliary passages are. The observation of Netter<sup>6</sup> is in accordance with Leubuscher's view that ligation of the common duct in animals is followed by an acute inflammation of the biliary passages. Here also the infection is with less likelihood due to an ascending process than to an inflammation induced by micro-organisms, possibly of intestinal origin, which, eliminated by the liver from the portal system, enter the bile ducts from above. Such an infection, however, does not necessarily follow a pathological occlusion of the common duct. Dr. Halsted recently removed a primary carcinoma of the duodenal papilla which had caused complete obstruction. Cultures from the common duct were negative as well as those from the gall-bladder, which was greatly distended by a pale mucoid fluid containing a deposit of fine biliary sand.

The typhoidal lesions, however, offer a portal of entry not alone for the typhoid bacillus but also for all other bacterial inhabitants of the intestine. The *Bacillus coli communis*, for example, which organism, recent observers, as Dreyfuss,<sup>7</sup> Sanarelli,<sup>8</sup> de Klecki<sup>10</sup> and others, have shown to acquire increased virulence in the presence of the inflammatory products of typhoid and other enteritides may similarly enter the portal circulation. This, Dr. Welch<sup>9</sup> demonstrated some years ago to be the case. The colon bacillus, however, apparently rarely passes beyond the liver into the general circulation, its ravages being limited to the confines of the portal system. It consequently may be as frequent a factor and indeed is actually a more frequent agent in the production of post-typhoidal gall-bladder complications than the specific cause of the disease itself. This has recently been emphasized in a paper<sup>11</sup> read before this society.

As was shown in one of the cases reported at that time, there was an active serum reaction toward both *B. typhosus* and the colon bacillus isolated from the gall-bladder. This increased virulence of *B. coli* in many cases of typhoid, being the cause of unusual agglutinative properties of the host's serum toward this organism,<sup>12</sup> may account for the occasional

clumping of *B. coli* in the bile when it has once entered the gall-bladder in correspondence with the reaction toward the bacillus typhosus which seems to be the rule there<sup>13</sup> at some period of the fever.

Salimbini<sup>14</sup> regarded the agglutinating property as one only acquired by the blood-serum after being shed, and expressed a disbelief in its occurrence in the living body. Durham,<sup>15</sup> however, disagrees with this on the ground that numerous observations on peritoneal injections in immunized animals have always shown that agglutination occurs within the peritoneal cavity. Since it has been proven that the bile of typhoid patients acquires agglutinative properties, this reaction *in vivo* in the gall-bladder naturally would occur in a fashion similar to that produced experimentally in the peritoneum. Richardson<sup>16</sup> has examined at autopsy the bile of fatal cases with this in view and found large clumps of bacilli in every case but one (five out of six). It is important to note that the blood-serum of this one case had failed to show an agglutinative reaction during life.

What relation the organisms have toward the deposition of bilirubin calcium and stone-formation has not been conclusively proven. The views of Naunyn<sup>18</sup> are generally accepted, though some of his chemical theories, chiefly that relating to the local production of cholesterin, have been questioned by Chittenden.<sup>17</sup>

The organisms may be present in the gall bladder just as in the urinary bladder during the course of typhoid fever without producing any evidence of cystitis whatever or exhibiting any tendency to become attenuated or to agglutinate, though the patient's serum may give a decided reaction outside of the body.

Just what influence tends to agglutinate the organisms *in vivo* and whether their "clumps" formed really act primarily as the nidus for stone-formation has not been actually demonstrated.

The mere clumping of the organisms in the bile has *in vitro* no macroscopical effect whatever on the bile. I have inoculated bile, aseptically withdrawn from the gall-bladder of animals, with the bacillus typhosus, and subsequently precipitated the bacilli by adding serum from a typhoid patient without producing any appreciable effect on the medium whatsoever.

The mere presence of the micro-organisms in the bile, however, may alone not be sufficient to incite the catarrhal process, the "lithogenous catarrh" of Naunyn, which is generally conceded to be an essential element in the process. I have never been able to produce any such catarrhal process in dogs or rabbits by simple intravenous injection of

either of most cases of biliary lithiasis; the organisms, being eliminated by the liver, enter the gall-bladder and under certain favoring circumstances produce lithiasis, which after the infectious agent has died out may give no subsequent symptoms. It is not improbable that a chronic enteritis such as may be associated with alcoholism may constantly feed the liver with intestinal bacteria, chiefly *B. coli communis*, and thus ultimately be responsible for the cirrhotic changes which take place there. The demonstration that the organisms found by Adams in cirrhotic livers are colon bacilli would favor this view.

\*The fact that human serum in health often possesses agglutinative properties toward varieties of *B. coli* probably is only an evidence of an acquired characteristic following an unrecognized invasion of the organism during the course of some preceding enteritis. Such an occurrence has probably been a secret fore-

the bacillus typhosus or by injection of the organism directly into the gall-bladder, though the animals have been examined at periods from a few days to several months.

Organisms may be recovered from the gall-bladder long after the original injection, and they frequently are found "clumped," as Blachstein<sup>18</sup> and Welch observed some years ago. The organisms may so remain for an indefinite period without producing any apparent inflammation of the mucosa. To induce this requisite catarrhal process, some other element, presumably some form of irritation such as traumatism or some hindrance to the proper evacuation of the gall-bladder, is necessary.

I am able to show to the society some small biliary calculi of typhoidal origin obtained from the gall-bladders of rabbits, in both cases at the time of inoculation the biliary apparatus having been intentionally maltreated.

On one occasion the organisms (non-attenuated) were inoculated directly into the gall-bladder, which had to be held tightly for some time by a piece of gauze between the fingers to prevent leakage after the syringe was withdrawn. At the autopsy, eight weeks later, three small millet-seed concretions were found adherent to the mucosa of an inflamed thickened and distended gall-bladder.

The second case (RABBIT IX of our series) is as follows:

March 17, 1898. Inoculation of 1 cc. of 24-hour bouillon culture of *Bac. typhosus* into ear vein.

March 19. Laparotomy. No evidence of inflammation. Cultures and cover-slips from gall-bladder and duodenum were negative for micro-organisms. Considerable traumatism of gall-bladder.

March 21. Second inoculation of 1 cc. of 18-hour culture of *Bac. typhosus* into ear vein. Animal quite ill subsequently, but recovered.

June 13. Widal reaction positive. Laparotomy. Marked evidence of cholecystitis. Gall-bladder bound up by adhesions in lappets of liver and identified with difficulty. One cc. of pale bile aspirated from gall-bladder. Stained preparations showed a few rod-shaped organisms. Culture=*Bac. typhosus*.

June 14. Animal found dead. Autopsy. Peritonitis. Serosa greatly bile-stained. Gall-bladder thickened, congested and densely adherent to liver. Contents: Small amount of pale mucoid material, and three gall-stones. The largest is dark-colored, somewhat irregular in shape, measuring 3 mm. in its longest diameter.

Decomposition had set in and bacterial observations were not made.

Possibly such a concretion may be regarded merely as a precipitation and not a true crystallization though it possesses the characteristics of a young biliary calculus having a marked cholesterin covering. The stone depicted by Richardson<sup>19</sup> and the early calculi described by Gilbert and Fournier<sup>20</sup> were evidently of this character. The concretions were regarded as stones in the primary stages of development. Their chief constituents are bile pigments combined with calcium. These bilirubin calcium concretions are less commonly found in the human gall-bladder where stones ordinarily contain a large predominance of cholesterin. Chittenden<sup>16</sup> says that bovine gall-stones possess this same characteristic and are often pure-pigment calculi, sometimes wholly without cholesterin.

Although Galippe,<sup>21</sup> as early as 1886, advanced the theory of a microbic origin of lithiasis in general, the chief credit

of the demonstration of the infectious nature of cholelithiasis belongs to Gilbert. The results of his observations, begun in 1890,<sup>22</sup> were utilized by Naunyn<sup>15</sup> at the Wiesbaden Congress in 1891, when he advanced his hypothesis on biliary infections. Since that time Gilbert, and his collaborators, Girode, Dominici, Claude and Fournier, have continued to publish the progress of their interesting and valuable investigations on the relation of infectious processes to diseases of biliary apparatus.

Experimental attempts to produce calculi of infectious origin were for a long time unavailing. In 1893<sup>23</sup> they first noted the presence of "*petites concrétions verdâtres*" which had formed during a typhoidal cholecystitis in a rabbit. Following this discovery, methodical attempts were made for a number of years to obtain more perfect and undoubted concretions. On January 29, 1897, these efforts were rewarded by the formation of a definite stone obtained from the gall bladder of a dog previously inoculated with the *Bacillus coli communis*.<sup>22</sup>

Gilbert and Fournier, however, failed to announce their results until after Mignot, who had entered the same field of work, had presented to the Société de Chirurgie, on the 19th of May, 1897, three small experimental calculi formed in a guinea-pig by *Bacillus coli*.<sup>24</sup> It was generally believed that the bacillus of Escherich played the most important part in these infections. Interest in typhoidal cholecystitis, however, led Gilbert to experiment with Eberth's bacillus and on October 30, 1897, he with Fournier,<sup>25</sup> profiting by Mignot's idea of attenuation, reported the production of biliary calculi in a rabbit resultant to an infection with *B. Typhosus*.

These calculi were regarded as stones in the primary stage of their development and from the description they must have resembled closely those produced by Richardson<sup>19</sup> and those shown to this society. The gall-stones, however, which Mignot succeeded in producing experimentally were said by Hartmann<sup>26</sup> and acknowledged by Gilbert<sup>27</sup> to have been identical in appearance with those commonly seen in human gall-bladders. These calculi were presumably five or six months old.

Various experimenters have adopted different methods in their attempts to produce infectious cholelithiasis. Endeavors to modify the composition of the bile and to alter the mucosa of the gall-bladder and to produce in divers ways a biliary stasis have equally been unrewarded.

The mere introduction of virulent micro-organisms alone as well as the introduction of aseptic foreign bodies<sup>28</sup> without micro-organisms have similarly been unsuccessful. Mignot claimed that one of the two conditions essential to the formation of calculi was the extreme attenuation in virulence of the microbe employed, and regarded the degree of virulence of the organism as more important than the species. Adopting this principle, Gilbert and Fournier,<sup>29</sup> by inoculating cultures of colon or typhoid, previously attenuated by heat, directly into the gall-bladder, were rewarded by finding some months later definite calculi, from the centres of which they recovered the original organisms.

This preliminary attenuation of the infective agent which

Mignot has found essential to the process may possibly, under certain conditions, take place in the body and be analogous to the agglutination of the organisms which takes place in the gall-bladder: the clumps, according to Richardson's hypothesis, forming the primary nidus of deposition for the biliary salts and pigments. In his attempt to form stones on this principle he inoculated an agglutinated culture of *Bacillus typhosus* directly into the gall-bladder of a rabbit and was successful on one occasion in producing a fair calculus.

Mignot,<sup>26</sup> however, claims that to produce true stratified calculi five or six months are requisite, and that a second condition, as important as the attenuation of the micro-organisms, is necessary, namely, the prevention of the premature expulsion of the soft concretions. This he accomplished in various ways. In his most recent article two especially characteristic cases are described.

In one of them the gall-bladder was tamponed in the presence of colon bacilli for one month. At the end of that time the tampon was removed and the gall-bladder closed. Fourteen months later, 7-8 faceted stones were found occupying the gall-bladder which presented the anatomical picture characteristic of old gall-stone cases.

In another case two gall-stones were made to form about a thread which was fastened into the wall of a gall-bladder previously inoculated with attenuated colon bacilli. Dr. John Homans<sup>27</sup> has reported a clinical experience similar to this experimental one in which at a second operation for cholelithiasis, gall-stones were found to have formed about the threads used at the primary operation in suturing the gall-bladder to the abdominal wall. There is no accompanying bacteriological note, unfortunately. These were large cholesterol stones such as Mignot has succeeded in producing and were found twenty months after the primary operation.

Mignot believes that the process of stone-formation and increment in the size of stones ceases with the death of the micro-organisms. Stones found in the gall-bladder are presumably on most occasions all of the same age, and always possess the same appearance, chemical composition and bacteriological characteristics. The original condition favorable to their formation, therefore, seems to be a transitory one. Old calculi are usually sterile, though their nuclei may contain the faintly-staining shadow of bacilli. Recently-formed stones contain micro-organisms. Mignot further believes that if stones in process of development are removed the chances are in favor of a new formation. This is an argument against the so-called "ideal" operation and justifies the clinical experience of most surgeons that it is preferable to drain the gall-bladder in recent cases till one is practically sure of the aseptic condition of the bile and convinced that the ducts are sufficiently patent to allow of the free escape of the contents of the gall-bladder. It is surprising that one does not more often encounter secondary formations of gall-stones after preliminary operations, when we consider that the combination of traumatism and necessarily-retained micro-organism is present, a combination most favorable for the experimental production of stones.

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#### NOTE ON NEW BOOKS.

A Clinical Text-Book of Medical Diagnosis for Physicians and Students. Based on the most recent methods of examinations. By OSWALD VIERORDT, M. D. Authorized translation, with additions by FRANCIS H. STUART, A. M., M. D. Fourth American edition from the fifth German; revised and enlarged, with one hundred and ninety-four illustrations. (Philadelphia: W. B. Saunders, 1898).

The appearance of a fourth American edition from the fifth German of Vierordt's "Medical Diagnosis," might seem to call only for general remarks on the merits and evident popularity of the work. It has been in its way so long a standard text-book that it hardly requires an introduction to American readers.

The principal additions mentioned by the author in his preface to this edition, have been made in the sections treating of gastric

digestion and diseases of the nervous system. A few things might still have been added; for example, there is here no mention of Turck's gyromele, or of several other apparatuses that have fully as much value as diagnostic appliances as some of those noticed at length. In the section on the nervous system the occasionally very confusing nervous symptoms of chlorosis appear to be unnoticed, which is an important omission. Other deficiencies might be pointed out, but in most respects the work seems well up to date, and a useful addition to any physician's library. The illustrations are well selected and generally very helpful; in this regard the work has a decided advantage over some other text-books on medical diagnosis.

#### BOOKS RECEIVED.

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In the methods of instruction especial emphasis is laid upon practical work in the Laboratories and in the Dispensary and Wards of the Hospital. While the aim of the School is primarily to train practitioners of medicine and surgery, it is recognized that the medical art should rest upon a suitable preliminary education and upon thorough training in the medical sciences. The first two years of the course are devoted mainly to practical work, combined with demonstrations, recitations and, when deemed necessary, lectures, in the Laboratories of Anatomy, Physiology, Physiological Chemistry, Pharmacology and Toxicology, Pathology and Bacteriology. During the last two years the student is given abundant opportunity for the personal study of cases of disease, his time being spent largely in the Hospital Wards and Dispensary and in the Clinical Laboratories. Especially advantageous for thorough clinical training are the arrangements by which the students, divided into groups, engage in practical work in the Dispensary, and throughout the fourth year serve as clinical clerks and surgical dressers in the wards of the Hospital.

### REQUIREMENTS FOR ADMISSION.

As candidates for the degree of Doctor of Medicine the school receives:

1. Those who have satisfactorily completed the Chemical-Biological course which leads to the A. B. degree in this university.
2. Graduates of approved colleges or scientific schools who can furnish evidence: (a) That they have acquaintance with Latin and a good reading knowledge of French and German; (b) That they have such knowledge of physics, chemistry, and biology as is imparted by the regular minor courses given in these subjects in this university.

The phrase "a minor course," as here employed, means a course that requires a year for its completion. In physics, four class-room exercises and three hours a week in the laboratory are required; in chemistry and biology, four class-room exercises and five hours a week in the laboratory in each subject.

3. Those who give evidence by examination that they possess the general education implied by a degree in arts or in science from an approved college or scientific school, and the knowledge of French, German, Latin, physics, chemistry, and biology above indicated.

Applicants for admission will receive blanks to be filled out relating to their previous courses of study.

They are required to furnish certificates from officers of the colleges or scientific schools where they have studied, as to the courses pursued in physics, chemistry and biology. If such certificates are satisfactory, no examination in these subjects will be required from those who possess a degree in arts or science from an approved college or scientific school.

Candidates who have not received a degree in arts or in science from an approved college or scientific school, will be required (1) to pass, at the beginning of the session in October, the matriculation examination for admission to the collegiate department of the Johns Hopkins University, (2) then to pass examinations equivalent to those taken by students completing the Chemical-Biological course which leads to the A. B. degree in this University, and (3) to furnish satisfactory certificates that they have had the requisite laboratory training as specified above. It is expected that only in very rare instances will applicants who do not possess a degree in arts or science be able to meet these requirements for admission.

Hearers and special workers, not candidates for a degree, will be received at the discretion of the Faculty.

### ADMISSION TO ADVANCED STANDING.

Applicants for admission to advanced standing must furnish evidence (1) that the foregoing terms of admission as regards preliminary training have been fulfilled, (2) that courses equivalent in kind and amount to those given here, preceding that year of the course for admission to which application is made, have been satisfactorily completed, and (3) must pass examinations at the beginning of the session in October in all the subjects that have been already pursued by the class to which admission is sought. Certificates of standing elsewhere cannot be accepted in place of these examinations.

### SPECIAL COURSES FOR GRADUATES IN MEDICINE.

Since the opening of the Johns Hopkins Hospital in 1899, courses of instruction have been offered to graduates in medicine. The attendance upon these courses has steadily increased with each succeeding year and indicates gratifying appreciation of the special advantages here afforded. With the completed organization of the Medical School, it was found necessary to restrict the courses intended especially for physicians at a later period of the academic year than that hitherto selected. It is, however, believed that the period now chosen for this purpose is more convenient for the majority of those desiring to take the courses than the former one. The special courses of instruction for graduates in medicine are now given annually during the months of May and June. During April there is a preliminary course in Normal Histology. These courses are in Pathology, Bacteriology, Clinical Microscopy, General Medicine, Surgery, Gynecology, Dermatology, Diseases of Children, Diseases of the Nervous System, Genito-Urinary Diseases, Laryngology and Rhinology, and Ophthalmology and Otolaryngology. The instruction is intended to meet the requirements of practitioners of medicine, and is almost wholly of a practical character. It includes laboratory courses, demonstrations, bedside teaching, and clinical instruction in the wards, dispensary, amphitheatre, and operating rooms of the Hospital. These courses are open to those who have taken a medical degree and who give evidence satisfactory to the several instructors that they are prepared to profit by the opportunities here offered. The number of students who can be accommodated in some of the practical courses is necessarily limited. For these the places are assigned according to the date of application.

During October a select number of physicians will be admitted to a special class for the study of the important tropical diseases met with in this region.

The Annual Announcement and Catalogue will be sent upon application. Inquiries should be addressed to the

REGISTRAR OF THE JOHNS HOPKINS MEDICAL SCHOOL, BALTIMORE.

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## THE GROWTH AND REGENERATION OF THE TAIL OF THE FROG LARVA\*

STUDIED WITH THE AID OF BORN'S METHOD OF GRAFTING.

BY ROSS GRANVILLE HARRISON, *Associate Professor of Anatomy, Johns Hopkins University, Baltimore.*

In the method of grafting we have a means of experimentation for which no substitute is offered. Born's discovery that certain amphibian embryos lend themselves with readiness to such operations, is of especial importance in that it renders the method applicable to the study of developmental problems. How important this form of experiment is, may be well appreciated from a careful study of the paper in which Born records the results of his work in this field.

In the spring of 1897 I instituted a number of experiments according to Born's method upon the embryos of several of to our American frogs, which were found to be well adapted for the purpose. An account of these experiments is here given.

The embryos of two of the forms used differ so markedly in coloration, that in any case where parts derived from each are united together into a single organism one may follow in the living specimen, as development proceeds, the movement of any group or layer of cells with respect to the original dividing line between the two constituents. By varying the region in which the parts are stuck together it thus becomes possible to trace out the mode of growth of individual structures or organs.

These circumstances were taken advantage of in a series of experiments which are described here in the second section.

They concern more especially the normal mode of growth of the tail from the time when the medullary folds are closed over and the tail bud is just formed; they form therefore the basis for the study of the later phases of development, beginning with the stage at which nearly all previous accounts leave off. During the development of the tail a remarkable shifting of the epidermis over the underlying organs was observed to take place. This was followed in some detail since it is of importance in explaining the mode of distribution of cutaneous nerves in the adult.

Another series of experiments, referring to the regeneration of the tail, was made with the special object in view of ascertaining to what extent the oral end or pole of the amputated tail rudiment is capable of regenerating. These are described in the third and fourth sections.

Finally, in the fifth section some scattered observations upon the fate of the tissues in the heteroplastic combinations are recorded.

The matter is thus considered under the following headings:

- I. Material and Methods.
- II. The Growth of the Tail and its Bearing upon the Mode of Distribution of Cutaneous Nerves.
- III. The Regeneration of the Tail.
- IV. The Regeneration of the Reversed Tail.
- V. Reactions between Tissues Derived from Different Species.

\* Reprinted from the "Archiv für Entwicklungsmechanik der Organismen," VII. Band.

## I. MATERIAL AND METHODS.

In the vicinity of Baltimore the spawn of various amphibia may be obtained in great abundance. For the purpose of experiment I made use of the embryos of *Amblystoma punctatum*, and of several species of frog, including *Rana sylvatica*, *R. virescens* (halecina), and *R. palustris*. The embryos of *Amblystoma*, however, are not at all adapted for transplantation experiments for the reason that their wound-healing power is but very slight. Since the yolk oozes out when laid bare instead of being quickly covered again by the overgrowth of the ectoderm, the whole embryo eventually macerates in consequence even of simple operations.\*

Of the three anuran species used all possess the power of rapid wound-healing which is the chief essential to successful grafting. For the present purpose the most fortunate combination between two species is that of *R. palustris* and *R. virescens*, on account of the very sharp color contrast, and the absence of undue difference in size between them. The eggs and embryos of the former are of a light yellowish-brown color, while those of the latter are dark brown, almost black. The coloration is due partly to the embryonic pigment situated for the most part in the ectoderm cells, and partly to the yolk granules, which are scattered throughout all the tissues. In *R. palustris* the latter are of a decided yellowish hue, while in *R. virescens* they are light-drab or almost white. The contrast between the two species is sharpest in the cells of the epidermis. In any combination of embryos of the two forms it is possible to distinguish in this layer the species from which every single cell is derived. In the structures underlying the epidermis the sharpness of the contrast is somewhat obscured (especially for the first day or two after union) by the imperfect transparency of the tissues. But even in the endoderm or in the axial musculature the specific coloration of the cells may be clearly made out. The distinguishing characters persist for ten days or more after grafting, and during this period many important developmental changes take place. After the expiration of this time the absorption of the yolk granules and the disappearance of the embryonic pigment from the epidermis cells make it more difficult to distinguish between cells of the two species. The perceptible differences between the two then no longer extend to each individual cell. This is true with regard to color differences, upon the existence of which the method is largely dependent, for the specific markings of older larvae are due to the characteristic groupings of the large mesenchymal chromatophores, rather than to differences in their individual form and color.

The embryos which were made use of in all the grafting experiments were in that stage of development in which the medullary folds are entirely closed over, and the tail bud is well rounded off from the trunk (Fig. 2).† In this stage the embryos of *R. virescens* are about 4 mm. in length, while those of *R. palustris* are slightly longer.

The spawning period of *R. virescens* is short. In the

spring of 1897 it lasted but about ten days (March 22 to April 1). The first eggs of *R. palustris* were found on April 1. For this reason it was necessary to resort to ice for the purpose of arresting development and prolonging the season during which grafting experiments could be carried on. The eggs were kept at a temperature just a little above freezing point of water without undergoing deterioration. They made but little perceptible advance in development during the five weeks they were retained.

Concerning the methods employed in transplantation, there is but little to add here to Born's account. In but one essential did the method pursued in the present research differ from his. That is, cool tap water was used instead of salt solution, as the medium in which the operations were performed. The former has two distinct advantages over the latter. In the first place it obviates the necessity of bringing the larvae back to their normal medium after operation and healing in salt solution. This, according to Born's experience, must be done very gradually and is a rather tedious process. The second and more weighty objection to the use of salt, is that the larvae show the effect of their treatment both in retardation of development and in general weakness.\* It is true that a larger proportion of experiments are successful initially when the operation is performed in salt solution, in which the wounds heal more quickly and surely. But the much larger percentage of healthy and vigorous tadpoles which survive in the end, when only cool, fresh water is used, more than compensates for the cases unsuccessful at the start. Nevertheless in any case, one must expect to lose many promising composite individuals, and very often, as Born points out, from causes apparently unassignable.

The method of study consisted largely in the daily observation upon the living specimen, although a quantity of material was preserved for histological investigation. The figures in the text (except Figs. 1, 14 and 18) are all reproduced from outline drawings of the living tadpoles made with the camera lucida. One experiences considerable difficulty in sketching the larvae by means of the camera, for it is almost impossible to keep them perfectly still. Care was taken, however, that the important parts (in most cases the tail) should be made perfectly accurate. In some cases the body and head were afterwards drawn in from preserved specimens.

The photographs reproduced in Plate X were made from the living tadpoles. Those of the four frogs (Pl. XI) were taken from specimens preserved in formaldehyde. For the purpose of photographing live tadpoles the apparatus, originally intended for photomicrography, was arranged as shown in the diagram (Fig. 1).† The larvae were put into a glass cell (*a*) having vertical plane walls and filled with water. This was placed directly between the camera (*c*) and the source of the light (*l*), an arc light of four thousand candle power.

\* Born mentions that operations of less difficult nature may be successfully performed in water. He also calls attention to the ill effects of keeping the larvae too long in salt solution. For a special study of the influence of salt solution upon the development of amphibia, which was first noted by Morgan (18), see Hertwig (10) and Wilson (28).

† This apparatus has been described in full by Hoen (11).

\* Born had the same difficulty with Triton embryos.

† This is perhaps a slightly older stage than that which Born found to be most advantageous.

This could be so adjusted by screwing from side to side that the rays, made parallel by passing through the condenser (*d*), were directed so as to pass somewhat obliquely to one side of the water-chamber, to the surface of a plane mirror (*m*), which was placed so as to reflect the light to the surface of the tadpole turned towards the camera. At the same time a small amount of diffuse light passed through the glass cell and likewise through the tail of the larva. The strong reflected light was to bring out the surface markings, while the transmitted light gave a transparent effect to the tail. Naturally, a great deal of experimentation was necessary before the proper proportions of reflected and transmitted light could be determined. The difficulty was increased by



FIG. 1.—Diagram showing method of illumination used in photographing living tadpoles. Explanation in text.

the fact that this proportion is different for each tadpole, since it depends upon the deepness of pigmentation. The intensity of the reflected light was found to be best left at its maximum, while that of the transmitted could be most conveniently regulated by the interposition of colored screens (*b*) of different actinic power. Exposure of several seconds upon very sensitive plates was necessary to bring out surface markings properly. This accounts for the blurred appearance of the mouth parts in the majority of the figures.\*

## II. THE GROWTH OF THE TAIL AND ITS BEARING UPON THE MODE OF DISTRIBUTION OF CUTANEOUS NERVES.

It is the generally accepted view that the tail of the vertebrate embryo increases in length by a process of apical growth. There is no doubt that the new muscle plates are added at the tip, and it is here that the notochord and spinal cord remain undifferentiated and contain numerous cells in process of division as evidence of active growth.

In the method of combining parts of differently pigmented embryos we have a means of testing whether the accepted view is correct as regards each of the individual constituents of the tail. For this purpose the following experiment may be made: The tail of an embryo of *R. palustris* is cut off and transplanted to the body of a *virescens* embryo in place of its own tail, which has previously been removed. The cut is best made in an oblique direction with respect to the axis of

the body in a line passing just distal to the anus (Fig. 2).\* The wound heals very readily after this light operation, but owing to the sharp contrast in color between the tissues of the two species the transplanted tail may be distinguished from the body even by the naked eye.



FIG. 2.—*Rana virescens* in grafting stage, showing cut made when tail alone is to be replaced.  $\times 11$ .

I give below the history of an individual case, the one from which the figures were made.

On the day after the operation the epidermis of the trunk (*R. virescens*) extends out over the base of the tail (*R. palustris*). The light ectoderm (stippled area, Fig. 3) of the grafted tail has increased in extent as compared with the day before, but not commensurately with the increase in length of tail, which is now considerably longer than at the time of operation. Two days after a still larger portion of the base

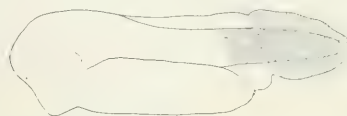


FIG. 3.—Same larva as in Fig. 2, thirty hours after operation. *Vi*rescens tissue simply outlined; *pa*lustris epidermis stippled; *pa*lustris musculature shaded.  $\times 11$ .

of the tail is covered by the same epidermis as the body, so that at this time but little over half of the tail is covered over by the transplanted epidermis (Fig. 4). On the fourth day, the length of the tail having continued to increase, the area



FIG. 4. Same larva, fifty-three hours after operation.  $\times 11$ .

of light-brown ectoderm becomes still further removed from the base. The line of demarcation still retains its oblique direction in a general way, but is becoming wavy or jagged, and is as a whole somewhat curved where it passes over the axis of the tail, the convexity being turned towards the distal end (Fig. 5). This is noticeable in all cases, though in a varying degree. On each following day the ectoderm of the

\*It gives me great pleasure to express here my obligation to Mr. A. S. Murray for much invaluable aid given in connection with the work of photography.

\*The oblique cut is preferable to the transverse in that it affords an easy means of distinguishing the dorsal edge of the small piece from the ventral.



trunk moves further and further out over the tail, the boundary between the two kinds of epidermis becoming more irregular and jagged (Fig. 6). The epidermal cells of the body do not cover up or replace those of the tail, however, for the surface covered by the latter continues to increase in absolute amount. By the eighth day or, in some cases, earlier, nearly two-thirds of the tail are covered by cells which have shifted to it from the body (Fig. 7). After the expiration of this time there is only a slight further change in the position of the line of demarcation. It may be made out in some cases for a week longer. Then, owing to the disappearance of yolk granules and of pigment from the epidermis cells, it becomes practically impossible to distinguish between the cells of the two species.

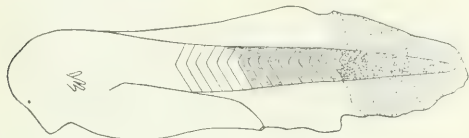


FIG. 5.—Same larva, seventy-seven hours after operation.  $\times 11$ .

In all, twenty cases were observed and without exception the changes just described took place, and in exactly the same manner in the reciprocal experiment where a virescens tail was grafted to the body of a palustris embryo. In a number of cases the tails of two larvae were merely interchanged, so that an exact comparison could be instituted.



FIG. 6.—Tail half of same larva, five days after operation.  $\times 11$ .

The changes in position of the boundary between the integument of the two components is due beyond a doubt to actual shifting of the cells and not to any mere diffusion of pigment granules. This may be clearly demonstrated by examining the border under moderate magnifying power with strong reflected light. This brings into view the individual cells. Those of each component maintain absolutely their specific coloring without there being any intermingling of pigment granules whatever. The boundary line is a zigzag one, the two kinds of cells being neatly fitted to one another.\*

With regard to the structures underlying the epidermis the changes of relative position which take place during growth are not so marked as in the epidermis itself. On the day after the operation the larva is still very opaque, but even then, with proper illumination, something of the deep-lying tissues,

more especially the muscle plates, may be made out. The line of demarcation between the muscle tissue of the virescens constituent (outlined in the figures) and that of the palustris tail (shaded in the figures) is seen to have remained at the base of the tail, very near to where it was just after the operation, while the epidermis of the body has crept some distance out beyond its original territory (Fig. 3). Three days after the

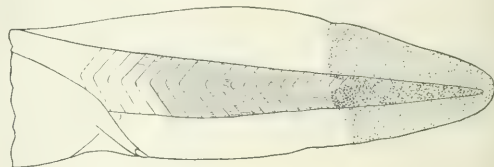


FIG. 7.—Tail half of same larva, seven days after operation.  $\times 14$ .

operation the individual muscle plates may be observed. The oblique cut made in operating has evidently affected several segments, for at least two of them are made up partly from each component. These two are nevertheless perfect in form (Fig. 5). During the three days the position of the junction between the two parts has moved slightly away from the head as compared with the position of the anus, regarded as a fixed point. This relative movement continues slowly (Fig. 6) until, about the eighth day, it amounts approximately to the length of three segments. The point of union, as seen on the ventral edge of the muscle plates is now considerably distal to the anus (Fig. 7), while a perpendicular drawn through the anus at this stage strikes the posterior part of the eleventh segment (counting from the head) instead of the fourteenth as at the time of operating. This change of position is due to the relative increase in the length of the individual muscle plates as compared with the length of the body (from nose to anus), which latter, as may be seen from the comparison of the sketches (Figs. 2-5), expands but slowly. Measurements made from sections of larvae preserved in stages corresponding to those shown in Fig. 2 and Fig. 7 demonstrate that the average length of the myotomes increases during this time about seventy per cent. of the original length, while the distance from the pituitary body to the anus (projected upon the notochord) increases but about forty per cent. This shows that differences in amount of interstitial growth will account for the relative change of position. Besides, as is well known, intercalation of myotomes during development and additions to the series from the cranial end have not been observed to take place. The shifting of the muscle plates out from the trunk to the base of the tail is accentuated in appearance by the increase in breadth of the fin-fold, by which the anal opening is removed to a considerable distance ventral to the limit of the muscle plates.

The growth of the notochord apparently keeps pace with that of the series of myotomes, and is due, as is well known, largely to apical growth. Further evidence of this is to be had from these experiments, for in grafting it is very seldom that the tissues of the notochord of the two components actually fuse together. They remain separated by connective tissue; the blunt ends where they abut against one another bend slightly

\* The shifting of the epidermis may likewise be demonstrated by following the movement of a scar during development. Byrnes (4) found that scars made in the region of the hind legs in embryos in the stage shown in Fig. 2 gradually pass out towards the tip of the tail.

to one side.\* During the growth of these transplanted tails it is in the distal piece of chorda that by far the greatest amount of increase in length takes place. The point of union of the two parts of the chorda dorsalis remains by the junction between the myotomes of the two components. The relative amount of interstitial and apical growth is, therefore, the same in both notochord and axial musculature.

Regarding the growth of the spinal cord the present experiments do not adduce new evidence. Its tip keeps up with the tip of the notochord as the tail grows. There is such complete union of the two portions of spinal cord in the healing of the wound after grafting that no scar remains as a landmark. That the greater amount of growth takes place from the end is, however, certain from the well-known fact that the interstitial growth does not keep pace with that of the vertebral column and segmental musculature, the circumstance which leads to the formation of the cauda equina.

The shifting of the epidermis tailwards over the underlying organs is not confined merely to the tail, as further investigation shows. In another series of experiments, instead of grafting only the tail to the body of another larva, a small portion of the trunk, say about four segments, including a portion of the yolk mass, was transplanted to the body of a larva of the other species, from which the same amount had been cut off. In such cases on the day after the operation the epidermis of the body has moved slightly towards the tail over the underlying tissues of the other component (Fig. 8).†



FIG. 8.—*Rana virescens* with tail and small portion of trunk replaced by palustris tissue, twenty-six hours after operation. Palustris epidermis densely stippled; palustris yolk and mesoderm covered by virescens epidermis lightly stippled.  $\times 11$ .

Four days after the operation the amount of shifting is so considerable that even the base of the tail is covered with the dark skin. The line of demarcation (between lightly and heavily stippled areas in the figures), originally straight, now takes a very characteristic sharp bend at the level of the middle of the muscle plates, so that while the dorsal portion passes ventrally and tailwards, the ventral portion has a ventral and cranial direction (Fig. 9). The skin of the dorsal half has moved further than that of the ventral. It seems probable that the movement is held in check ventrally by the opening of the alimentary tract, where the epidermal cells are continuous with the cells lining the cloaca. In the underlying organs some changes have also occurred. The muscle plates of the posterior component are pushed further

towards the tail as compared with the yolk. The limit between the muscle tissue of the two parts retains its original direction, but between the two kinds of yolk this is not the case, for here the boundary is either nearly perpendicular or runs ventrally and headwards. The shifting of the epidermis continues until the integument of the anterior component extends to a point just beyond the anus ventrally, while dorsally a considerable stretch of the tail is covered by it. In amount, the movement is considerably less in this region than further towards the tip of the tail, as demonstrated in the first series of experiments.



FIG. 9.—Same as Fig. 8, four days after operation.  $\times 11$ .

Even in the region of the pronephros and forelimb there is a slight change in position of the ectoderm with respect to the underlying organs as development proceeds. This is clearly shown in specimens in which the two constituents are united in this region. After the expiration of a week the position of the border between the two kinds of skin may be observed to have shifted somewhat in the same direction as in the posterior part of the trunk and tail, though relatively much less in amount.

The explanation of this general movement of the epidermis from the head towards the tail is to be sought in the absence from this tissue of any definite growing point such as is found at the tip of the axial organs of the tail. At least, if there is a greater proliferation of cells in the epidermis of the tip than elsewhere over the body, it is not sufficient to keep pace with the general increase in length. A glance at the figures used in the foregoing description shows that during the one week in which this shifting takes place, the tail grows from almost nothing to a length greater than that of the rest of the animal (cf. Figs. 2, 5 and 7). The consequence of this rapid growth is a steady pulling of the covering of the body out to the tail, since the attachment of the epidermis to the underlying tissues must offer but insufficient resistance to this movement. The greatest amount of shifting is found in the cells nearest to the tip, and it becomes less and less as the head is approached. A given cell located originally at the posterior limit of the fourteenth myotome moves during seven days to a point at least 2.5 mm. further peripherally, that is, through a distance equal to about fourteen segments. Of course it is probable that a certain amount of the movement is due to the protoplasmic activities of the ectoderm cells themselves, as we have good evidence of the amoeboid activity of such cells, especially in the covering of wounds, and in fact when the tail is amputated.\*

\* Cf. page 186. Also Born, l. c. page 394.

† For a day or two after the operation in such cases a very marked constriction where the two portions of yolk join may be observed. This disappears entirely in the course of time, and the composite larva assumes a normal appearance.

\* The covering of the wounds through the amoeboid activity of epidermis cells was first demonstrated by Peters (20) in the case of the frog's cornea. Barfurth (2) confirmed this result in his study of wound-healing after amputation of the tail.

To sum up, then: The tail of the tadpole increases in length by a process of apical growth in the musculature, notochord and spinal cord, and also, but to a much less extent, by the greater amount of interstitial growth of these parts as compared with that of the body as a whole; this latter factor results in the pushing of about three segments from the body to the base of the tail. Little or no evidence of apical growth is to be found in the epidermis, which gradually moves out from the body to the tail, so that finally two-thirds of the latter become covered by skin from the body.\*

The gliding of the skin over the underlying organs is a most interesting phenomenon when considered in connection with the mode of distribution of the cutaneous nerves in the adult vertebrate.

As is well known, the integument of the trunk is divisible into a series of zones, each of which corresponds to the area of distribution of a given spinal nerve. There is an overlapping of adjacent zones, but the sensory areas of the individual nerves are continuous, at least in those portions of the trunk left undisturbed by the growth of the extremities. The portion of the skin innervated by a given spinal nerve does not necessarily exactly overlie the muscular zone which is supplied by the ventral root of the same nerve. In the region of the first dorsal vertebra the limits of the sensory and motor belts do correspond very nearly, but on passing towards the tail the discrepancy between the two increases. The sensory area lies relatively further tailwards than the corresponding muscles.† The cutaneous nerves in passing to the skin take a more and more oblique direction the further tailwards their origin.‡ In the tadpole those nerves which run to the tip of the tail arise not far from its base and pass nearly longitudinally to their destination.

The shifting of the epidermis during development over the subjacent muscle plates, as ascertained above experimentally, corresponds in direction and in relative amount in the different regions with the displacement of the sensory area as compared with the motor belt of the same segmental nerve. In the region of the upper dorsal vertebrae there is but little shifting and but a slight segmental discrepancy between sensory and motor zones, while both increase gradually as the tail is approached.§

\* This supports H. Virchow's (23) conclusion drawn from the study of the formation of the tail in Elasmobranchs.

† This has been shown physiologically most recently by Sherrington (22) who has worked the matter out especially carefully on the monkey, *Macacus*, giving a full account of previous work upon the subject. Unfortunately, in the frog, his study was confined to the hind limbs alone and did not include the trunk. In man the sensory areas have been very completely defined, clinically, by Head (7) whose diagrams show very clearly the increasing discrepancy between the level of the exit of the nerve from the vertebral canal and its area of distribution in the skin, as the sacral region is approached. As Sherrington points out, there is more than a general correspondence between his own results and those of Head.

‡ This is independent of the oblique course taken by the nerves in passing from the origin in the cord to those points of exit from the vertebral canal, which is accounted for by the unequal growth of the spinal cord and vertebral column.

§ When the position of the sensory area is compared with the point of origin of the nerve from the spinal cord, the segmental

Wandering of skin, then, like wandering of muscles, occurs during development, but the nerves remain to indicate the course of this ontogenetic wandering of the one as well as of the other.

These considerations suggest that a connection between each ganglion cell and its end organs in the integument is established early in development, and that each nerve rudiment in its first stage passes from its origin in the ganglion cell by the shortest path to the integument; and conversely, that each portion of the integument in this stage is innervated by that nerve the root of which has its origin nearest to it. The more complicated relations found in the adult are due to the gradual drawing out of these connecting nerves, as the parts separate during development.\*

There is indication that in each region where there is discrepancy between sensory and motor zones, the cause of the shifting is to be sought in the actual pulling of the skin, which results from the unequal growth of subjacent structures in the embryo. Thus, in man the rapid growth of the hind limbs would have the same effect as that of the tail of the tadpole in pulling the skin from above. Likewise, it does not seem improbable that the great increase in the size of the brain may account in the same way for the distribution of cervical nerves to the occipital region.

Of course it is meant to explain in this way only the course of the main nerves and not the finer anastomoses, and it is not intended to deny that other factors than the shifting of the skin play a part in determining the course taken by its nerves in the adult. For instance, this must certainly be the case with the lateral branch of the vagus; for the sense organs of the lateral line in the grafted larvae just described form a complete series extending to the extreme tip of the tail and continuing without break or bend from the integument of one component to that of the other, although, as can be directly observed, all of them receive fibres from the *ramus lateralis vagi*, which are derived entirely from ganglion cells of the anterior component. This must mean that in this case a connection is established secondarily between these ganglion cells and the sensory cells in the epidermis of the transplanted piece. This probably takes place in the same manner as a severed nerve grows out again to its end organ.

### III. THE REGENERATION OF THE TAIL.

For the purpose of controlling the experiments described in

difference between the two becomes even more marked. And this difference affords a much more exact measure of the amount of shifting of the skin, since, as shown above, the muscle plates shift considerably in the same direction during development.

\* This conclusion is identical in part with the well known view of Hensen (8, page 121), "*dass die Nerven nicht ins Gewebe hineinwachsen, sondern durch die allmähliche Entfernung der einzelnen Zellen und Gewebe von einander ausgezogen würden.*" But it cannot be said to lend positive support to the opinion expressed less reservedly in a later paper (Hensen, 9, page 373), "*dass die Nerven niemals ihrem Ende zuwachsen, sondern stets mit demselben verbunden sind.*" Nor do the observations above described offer any evidence as to exactly how and when the connection between nerve cell and end organ arises. They are, therefore, not to be construed as necessarily contradicting the view, at present almost generally accepted, that each axis cylinder grows out centrifugally from the ganglion cell to the end organ.



the second and fourth sections the normal regeneration of the tail was studied. The following account based upon this study refers almost exclusively to the regeneration of the peripheral nervous system, concerning which some new observations are recorded. These, while supplementing our meagre knowledge of this subject, are still of a preliminary nature.\*

The material used consisted of larvae of *R. palustris* and *R. virescens* in three different stages of development. All of these are much earlier than those studied by previous writers. The youngest stage is the same as that used for the transplantation experiments (Fig. 2). The next stage is represented by larvae two days older (6.5 mm. long) and the third by those six days older than the first (9 mm. long). On account of the absorption of the greater part of the yolk having taken place in the last named, these were found to be the most favorable for histological study, and it is upon these that the description is largely based. Serial sections, best cut parallel to the frontal plane, were found to be indispensable.

The regularity with which the tail is regenerated is remarkable although, even in outward appearance, the regenerated appendage (Figs. 2 and 4, Pl. X) never becomes exactly like the original (Figs. 1 and 3, Pl. X). In the former the series of muscle plates does not taper quite so gradually to the end, and there is an absence of that slight thickening in the axial muscles which marks the middle region of all normal tails. Besides, the regenerated tails are much more heavily pigmented than the ones which they have replaced, and in *R. virescens* there are three or four blotches of black pigment arranged in a row along the lateral line which are not found in the original tails (Fig. 2, Pl. X).

The changes which mark the beginning of the rehabilitation of the peripheral nervous system of the tail may be observed within the first twenty-four hours after amputation.†

In a specimen preserved eighteen hours after amputation, which is the earliest stage examined, a few fine nerve fibrils are seen to pass out from each side of the spinal cord at a point very near to the cut end. These arise from cells within the cord and have been regenerated since the operation. They are distinct from the fibres which comprise the last nerve root arising from the old part of the cord. The ganglion of this nerve was removed in the operation, but the fibres of the motor root are seen to pass obliquely outwards and backwards. In later stages they mingle with the fibres regenerated from the cut end of the cord.

In a specimen preserved forty-three hours after amputation the new nerve is very well marked, and contains a very considerable number of fibres. The spinal cord is entirely closed in and now extends 0.2 mm. beyond the origin of the nerve, indicating new growth to that amount. At the root of the nerve and extending both proximally and distally within the substance of the cord there are situated a number of ganglion

cells, which are still but slightly differentiated. It is from these cells that the nerve fibres, at least in part, arise. The new nerve is joined by a number of fibres from the next nerve root, which is the last one arising from the old part of the cord and from which the ganglion was cut off. Likewise this is connected with the last of the remaining ganglia by means of a longitudinal commissure.\* And in this particular case, upon which the description is based, though not in all others, an anastomosis exists between the newly regenerated nerve and the *n. lateralis vagi* which passes along the lateral line close by.

After the new nerve trunk is formed, as later stages show, many of the ganglion cells which were situated at the root of the nerve wander out from the cord and form a large peripheral ganglion.† In some cases a chain of ganglion cells extends from the last ganglion of the old part of the tail to the new ganglion, so that some of the cells of the latter may possibly be derived from the persisting ganglia. In other cases this is not true, and in all cases observed the majority of the cells of the new ganglion are traceable directly to the cord. What is more remarkable, the cells which arise from the cord seem to come rather from its ventral side, although the cord is in this region so slender that a division into the dorsal and ventral zones of His can scarcely be made out. Even when the new ganglion is fully developed, a number of nerve cells still remain in the cord grouped around the point of exit of the nerve. These no doubt represent the motor elements, while those which wander out are the sensory cells.

The essentials of this new development of the peripheral nervous system take place within the first five days after the removal of the old appendage. At the end of this time the new nerve may be followed for some distance peripherally, where it seems to end in close proximity to the regenerating muscle cells.

In tails which have regenerated five days or more a few ganglion cells may usually be found scattered along the new peripheral nerve trunk. Later these cells segregate into several groups. In a specimen regenerated ten days two such groups of cells were found, and the diminished size of the original regenerated ganglion indicated that migration of cells from there had taken place. This may be interpreted as an attempt to restore the more distally situated ganglia which were removed in amputation.

The study of much older stages shows, however, that the lost ganglia are never entirely restored. In a case where the tail had regenerated for over two months no nerve cells are to be found in the new portion of the tail beyond the original regenerated ganglion, which is situated opposite the twelfth myotome. This ganglion is large and from it several stout nerve trunks pass to the periphery, forming anastomoses with nerves arising further headwards.

In another specimen regenerated the same length of time two groups of ganglion cells were found on the regenerated

\* Fraise (6) and Barfurth (2), treating of the general subject of regeneration, devote much attention to the study of the amphibian tail. A full account here would therefore necessitate much repetition.

† In this respect the younger larvae here studied must differ markedly from the older ones, where, according to Barfurth, the peripheral nerves are the last structures to begin regeneration.

\* Such longitudinal commissures connect all the nerve roots of the normal tail as was shown by Hensen (8).

† The presence of this ganglion has been noted by Barfurth (2, page. 428).

nerve, and in still another, three groups of cells were present. With the exception of but one case it has not been possible to demonstrate separate dorsal roots in connection with any of these secondary ganglia; nor, as far as could be observed, do any motor roots leave the cord at any point distal to the origin of the first regenerated nerve. At least, no noticeable nerve trunks do. Nevertheless, there are a considerable number of ganglion cells and nerve fibres in the regenerated part of the cord, so that some fibres may be given off from here at intervals, perhaps singly and sporadically.\*

The difference between the innervation of the normal and of the regenerated tail is, however, not so great as might be assumed from the above account, for the ganglia of the normal tail extend by no means to the tip.† In *R. palustris* at least the distal half of the tail is destitute of spinal ganglia. The greater part of the tail fin is innervated by branches of the large nerve trunks which arise near the root of the tail, and which, forming a plexus, give off branches to the skin and muscles of the distal part.

In the lizard, according to Fraisse, no spinal ganglia are regenerated at all after amputation of the tail, and the regenerated part of the spinal cord remains in a rudimentary condition. The new tail is innervated by three pairs of stout nerve trunks which arise from the last segment of the uninjured part of the cord. The last ganglion as well as the roots of the nerve pair are much larger than usual.‡ In *Pleurodeles* the ganglia are regenerated from the ventral side of the spinal cord, while in *Proteus* ganglia of the tail which here extend to the tip, develop in the embryo in the same way.§

The condition found in the regenerated tails of anuran larvae (*R. palustris* and *R. virescens*) seems, therefore, to be intermediate between the conditions found in the *Lacertilia* and the *Urodela*. As compared with the regenerated tail of the lizard, that of the tadpole more nearly attains the condition found in the normal tail.

#### IV. REGENERATION OF REVERSED TAILS.

The study of regeneration shows that a lost appendage is reproduced in a manner much the same as the original mode of development. After amputation of the tadpole's tail a new one grows out which closely resembles the one cut off. The "polarity" of the organism is maintained. On the other hand, tails which have been severed from the body do not regenerate the lost trunk and head, as is true of almost any portion of such animals as planarians or hydroids, where the power of regeneration is well nigh perfect. Nevertheless, a tail removed from the body when yolk is present in its tissues, may live for ten days or more, and besides undergoing normal growth and differentiation, may show signs of beginning

regeneration headwards.\* It might, therefore, be urged that non-regeneration is due to lack of food supply. By the method of grafting it is possible to implant an amputated tail by its distal end into the body of another larva, and thereby supply it for an indefinite period with proper nourishment, so that its capacity for regeneration from the head-end may be tested under favorable conditions. These transplanted pieces may be placed in what is termed the reversed natural position that is, in place of the removed tail, or they may be grafted to any desired region of the body of another individual.

It is obvious that in the former case two like ends or "poles" are united together. The free head-end of the grafted stump is in the same position with regard to the whole organism as is the free tail-end of a larva from which the tail has been cut off. But a tail is necessary to complete the organism in the former as well as in the latter case. The question then arises, whether a tail will be produced under the influence of the position of the regenerating centre with regard to the whole organism, or whether the elements in the transplanted stump retain their original orientation and strive to reproduce the lost body.† By varying the position of the transplanted piece, as mentioned above, it is possible to test the influence of functional activity upon the regenerating parts.

#### A. Tails Grafted in Reversed Natural Position.

Owing to the small size of the tail-bud at the grafting period it is impossible to perform directly the experiment in which the tail is reversed. The double wound which would be necessary in order to do this is sufficient to cause the maceration of such a small piece. In order to avoid, therefore, two simultaneous cuts, the tail-buds of two larvae may be cut off and the larvae brought together end to end. After the expiration of a certain time (from one to six days) when the two individuals are firmly united and the tail stumps of each stand out more or less from the body, the two may be cut apart as shown in the sketch (Fig. 10). Thus a small part (as future development shows, portions of three or four myotomes) of the base of the tail of one larva is left attached to the tail-stump of the other, but obviously the two ends of the transplanted piece are reversed. That which was turned headwards when in connection with its own body now forms the free distal end of the tail of the new individual to which it is attached. After cutting apart, both larvae may be kept

\* Cf. Hensen (8).

† This has been clearly demonstrated by Hensen (8) who has given an admirable description of the nerves of the tail. This has been supplemented more recently from the histogenetic side by von Kolliker (13).

‡ Fraisse, page 120.

§ Fraisse, page 123.

\* Vulpian (25) and Born (3) have made a study of the life of such isolated tails. The latter records that both notochord and spinal cord show signs of regeneration headwards, and that they grow out to some extent into a kind of fin-fold formed by the growth of the epidermis out beyond the surface of the wound. The cut muscle fibres show signs of degeneration as is usual before the actual regeneration begins, although in these cases the process does not pass beyond the initial stages. A full account of Vulpian's work is given by Born (p. 378).

† This is analogous to Morgan's (17) experiment with earthworms. Wetzel (27) has also recently made a similar test with hydra (see foot-note p. 188).

under the same conditions and observed daily in order that the regenerative process in each may be compared.\*

This experiment was made in a large number of cases. The results were, however, in a high degree variable, so that it will be necessary to describe a number of individual cases. It seems best to begin with the one in which regeneration took place most regularly, that is, in a manner most like the normal regeneration from the caudal end.



FIG. 10.

CASE 1. Two days after operation, showing cut made to separate the two components.  $\times 8$ .

CASE 1.—Both components *R. virescens*. Cut apart two days after union (Fig. 10). On the day after cutting, the epidermis could be seen to extend a short distance beyond the axial structures as a result of the general backward shift-



FIG. 11.

CASE 1. Three days after cutting apart. *a*, combined larva; *b*, accessory larva.  $\times 8$ .

ing of the whole layer. There is a slight swelling in the axial musculature where the tissues of the two constituents adjoin. Three days after cutting the epidermis has pushed out much further, and its periphery is still rough as in the initial stages of ordinary regeneration (Fig. 11, *a* and *b*). The axis of the tail tapers out to a point and there is already an increase of tissue at this growing end. The cells being still full of yolk granules, the larvae are so opaque that the exact lines of internal structures (myotomes, notochord, etc.) cannot be made out. Comparison of the two larvae shows similarity in the conformation of the tips of the tails.

On the sixth day enough yolk is absorbed from the tissues to render the tail more or less transparent, and now the blood may be seen for the first time circulating in the tail, in the transplanted stump as well as in the larva proper. The fin-fold has grown still further distally, and although there are still a number of surplus cells along its periphery, which give it a ragged appearance, its end is beginning to round off (Fig. 12). The transparency of the tissues now enables one to make

out the contours of the muscle-plates, which are by this time distinctly V-shaped. In those derived from the principal larva, the angle of the V-points, of course, away from the tip of the tail, but those of the transplanted piece are reversed. They are oriented just as they would have been had they never been removed from their original position. This characteristic

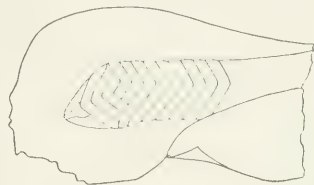


FIG. 12.

CASE 1. Tail portion of combined larva (Fig. 10 *a*) five days after cutting apart.  $\times 14$ .

shape of the muscle plates had been acquired, however, before the two larvae were cut apart, to some extent even before they were stuck together. The myotomes of the two constituents are dovetailed together. The notochord may also be clearly seen. It extends a short distance out beyond the original muscle-plates. Between the latter and the tip of the notochord there are numbers of undifferentiated sarcoblasts.

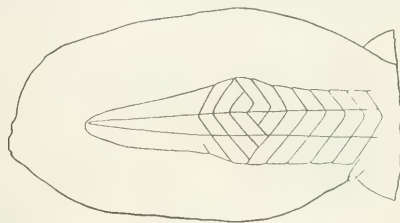


FIG. 13.

CASE 1. Nine days after cutting apart.  $\times 14$ .

On the tenth day, still further advance in development is to be noted. The fin-fold is now well rounded off, and is beginning to become pointed as in the normal tail (Fig. 13). A slight aggregation of superfluous ectodermal cells makes a little thickening at the tip. The blood circulation is well established throughout the whole tail. The contours of the muscle-plates, where the tissues of the two constituents adjoin, are about the same as they were when first noted. Measurements show that the notochord has grown 1.5 mm. in the last four days. Differentiation in the regenerated portion is progressing. The more proximal of the sarcoblasts situated between the old myotomes and the tip of the notochord have given rise to muscle fibrils in which cross striation is plainly visible.

On the fifteenth day, the transplanted portion of the *chorda dorsalis* is over four millimetres in length. The tail now tapers gradually to a point, and can scarcely be distinguished from a normal tail except for the slight swelling of the

\* Of course, in the strict sense, this comparison should be made between regenerating grafted tails placed in normal orientation, and regenerating reversed tails, but since it can be shown that the grafted tails regenerate as readily as original tails, this precaution does not seem necessary (page 190).



muscle-plates at the place where the two larvae were stuck together. Moreover, the creature is now very active, and swims as well and as rapidly as any other tadpole of its own size.

On the twenty-ninth day the transplanted portion of the notochord has attained a length of 7 mm. The whole length of the organism is 17.5 mm., of which 10 mm. is tail. The tail of the larva with which this was united is just 10 mm. long, although the body is somewhat longer, 8 mm. It is seen, therefore, that the normally regenerated tail has grown quite a little faster than the appendage regenerated from the head-end, for, at the start, the former was shorter than the latter by the length of about six myotomes. The reversed tail is slightly crooked. The tip, for instance, is bent over to the right side. This does not, however, interfere with the rapid locomotion of the animal.

This irregularity increased but little as time went on, as may be seen from comparing the two photographs (Fig. 14 and Fig. 15, Pl. X) taken respectively thirty-eight and eighty-nine days after the cutting of the larvae apart. The musculature is somewhat stouter than in an ordinary tail (Figs. 1 and 3, Pl. X) or even in a normally regenerated tail (Fig. 2, Pl. X). The whole appendage is not so long and the fin-fold is broader and more rounded at the tip. The notochord has evidently grown more rapidly than the other structures, and hence takes a wavy course from base to tip. The tail is also very heavily pigmented, and although all regenerated tails of *R. virescens* are darker than the normal, none were observed so dark as this and other reversed ones. The creature has grown on the whole more slowly than the average, and is inferior to its fellow in size, although it is very active and uses its tail to as much advantage as a normal individual. Stimulation of the extreme tip with the point of a sharp needle brings about the usual sudden reflex.

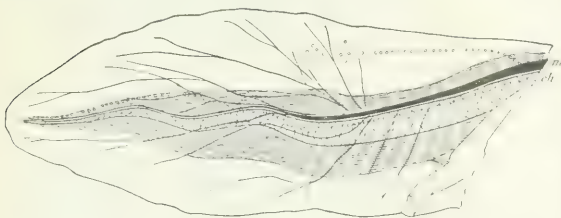


FIG. 14.

CASE 1. Ninety-five days after grafting apart, as seen after staining and clearing. *m*, spinal cord; *ch*, notochord; *ooo*, sense organs of the lateral line.  $\times 6$ .

A little over three months after grafting, this specimen was preserved for the purpose of more minute examination. After being stained and cleared, it was first studied *in toto* as a transparent object, and was cut afterwards into a series of frontal sections. The main features of the tail seen as a transparent object are shown in Fig. 14. The notochord passes continuously from the region of the principal larva out into the grafted tail. An examination of the sections shows beyond doubt that the chordal tissues of the two constituents are fused completely with one another. This is unusual, and

no doubt accounts for the exceptional degree of perfection attained by the regenerated tail in this individual case. The contours of the original muscle-plates, although considerably obscured by pigment, may nevertheless be traced out, and are substantially the same as when first observed. The regenerated fibres do not form very definite muscle-plates, but are divided up into bundles which overlap more or less with each other. The individual fibres are somewhat shorter than those at the root of the tail. A vague tendency to regular arrangement may nevertheless be made out. In the proximal part of the regenerated tail this is less apparent, but distally there is a grouping of the bundles into fairly regular segments. The contour of those quasi-myotomes tends to correspond to that of the myotomes of normal tails. They are not reversed. The spinal cord extends out to the tip of the tail and follows closely the wavy curves of the notochord. The regenerated part contains few or no ganglion cells or nerve fibres, and seems to have remained in a still more rudimentary condition than the new growth of cord in normally regenerated tails. The peripheral nerves radiate from a region in the non-regenerated part of the tail, both from the region of the larva proper and of the reversed piece. A large ganglionated plexus is situated there, the nerve cells of which are probably derived from both constituents.\* Thence the sensory nerve fibres pass to all parts of the fin-fold (see Case 3). Those which are destined for the extreme tip of the tail pass almost longitudinally between the muscle-plates of the two sides and emerge into the fin fold well on towards their peripheral ends. One pair of nerves passes for some distance very close and parallel to the spinal cord, but in the regenerated part of the tail no nerves could with certainty be observed to arise directly from the cord.

The main series of sense organs of the lateral line has exactly the same position and distribution as usual. It extends along the side of the tail at the level of the notochord, following at first the bend of the latter. At the beginning of the distal half of the tail it passes gradually to the level of the dorsal edge of the muscle plates, along which line it extends as far as the tip of the notochord. The dorsal series of organs situated on the dorsal fin-fold are not so regular and do not extend so far peripherally as is the rule. Some interruption to their normal development must have occurred.

CASE 2.—Both components *R. virescens*. Cut apart after being united six days. At the expiration of this time the yolk was for the greater part absorbed and the two larvae were quite active, struggling always in opposite directions. When cut apart in the same manner as in the previous case, blood streamed out from both larvae, showing that circulation had been established from one to the other.

Regeneration took place as in the Case 1, but perhaps not quite so typically. The tail was considerably more blunt (Fig. 17, Pl. X). Functionally, however, it was a very satisfactory organ; this larva was one of the most active of those experimented upon. The arrangement of the muscle fibres

\* This is certainly true in a number of other cases, which were preserved and cut into sections at a much earlier stage of development.

and the general distribution of the peripheral nerves in the fin-fold is the same as in the first instance. This specimen was kept alive for eighty-two days. At the expiration of this time the hind legs had developed to a considerable extent, although they were by no means so far along as is usual at the time of metamorphosis. Nevertheless, signs of degeneration were beginning to manifest themselves at the tip of the tail in the form of shriveling of the fin-fold and the extremity of the axial structures (see page 189). The specimen was preserved before the atrophy of the grafted tissues was complete.

CASE 3.—In this experiment the two constituents were stuck together in the same way as before, but one of them was a palustris larva, while the other was a virescens. After being united for two days they were cut apart as shown by the line in Fig. 15, the virescens larva being left with a small portion

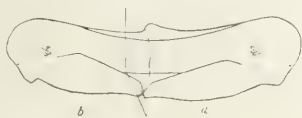


FIG. 15.

CASE 3. *a* virescens, *b* palustris constituent,  $\times 8$ .

of palustris tissue attached. It will be seen that a small bit of yolk, including the anal opening, was cut off along with the tail stump. At the time of cutting the epidermis of neither larva had encroached upon the other, the pressure from each end being presumably the same. Six days after this the epidermis of the virescens was seen to extend well out over the palustris tissue dorsally. The line of demarcation (Fig. 16) between the two extended from the tip of the tail



FIG. 16.

CASE 3. Tail portion of virescens component (Fig. 15 *a*) six days after cutting apart. Stippled field, palustris epidermis; shaded field, palustris musculature; *d* palustris yolk.  $\times 14$ .

ventrally and headwards until a little below the level of the notochord where it was seen to bend ventrally. Apparently the boundary had remained nearly fixed in its ventral portion, the movement being held in check by the two anal openings (cf. page 177). This shifting of the epidermis in the same direction as in normal growth helps to explain the course taken by the nerves in the first case described. The arrangement of the muscle plates presented about the same peculiarity as in the former cases. The mass of grafted yolk retained its position and on the sixth day was still but little differentiated. The end-gut of the principal larva seems to have been fastened

to that of the grafted piece, for it was pulled out horizontally beyond the usual distance. This defect was corrected as development proceeded.

This specimen continued to thrive. Fifteen days after cutting the transplanted notochord had attained the length of 3 mm.,\* the whole tail being about 5.5 mm. long. In view of the almost perfect regeneration of this tail it is highly probable that the two notochords were entirely fused (see page 463). It was able to swim actively, being hindered only to a slight extent by the presence of the small mass of endoderm attached to the tail. This marked the place of union of the two constituents, and by this time was fully differentiated into a miniature coiled intestine, which was suspended by a mesentery in a small body cavity, and could be observed to undergo continual peristaltic movement. Blood could be seen circulating freely in the walls of the intestine and mesentery. Unfortunately, this larva died shortly after these last observations were made, and was not available for histological study.

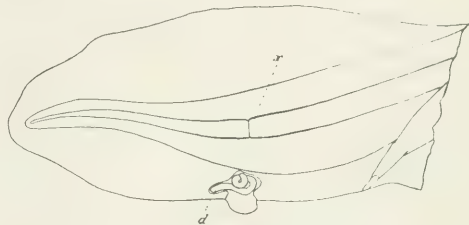


FIG. 17.

CASE 3. Tail portion of *a* (Fig. 15) fifteen days after cutting apart; *d* intestine developed out of grafted yolk.  $\times 14$ .

Sections were cut off several other specimens which had been treated in the same way. The intestine was found to contain a number of free cells, but of course no food matter. The anus was preserved intact and in one instance the rudiments of the hind legs, which had been removed with the piece of yolk, could be detected. These instances indicate the high degree of specialization of the tissues at the time of grafting even though it may not be always visible to the eye (see note, page 187).

CASE 4.—In this case the two larvae, both virescens, were cut apart three days after union. At this time the epidermis covering the wound had begun to show signs of unevenness and crumpling. Two days after cutting apart a small hump made its appearance on the dorsal side of the muscle plates at the place where the two components were combined. This increased rapidly and formed a prominent projection, which on the twenty-sixth day had attained the length of 1.5 mm. The body of the larva had then attained a length of 7 mm. and the tail 8 mm. The notochord of the transplanted piece was but 2.5 mm. long as against 7 mm. in Case 1. The exter-

\* I cannot be quite sure of the exact length of this because the place of union could not be made out in the living specimen, although there were indications of a line at  $\times$  Fig. 17.

nal form of this specimen as it appeared forty-five days after the operation is shown in the photograph (Fig. 16, Pl. X). After being strained and cleared it was ascertained that the notochords of the two constituents had not united, but that their ends overlap somewhat and are bound together by connective tissue. At the point where the two spinal cords were joined together there is a vesicular enlargement, triangular as seen from the side in optical section. Extending from the apex of this triangle a short prolongation of the cord accompanies the dorsal prolongation of the muscle-plates mentioned above. In this case the two constituents were evidently not united so exactly as in Case 1, so that the tissues of the main larva had an opportunity to grow out. Correspondent to this there was a retardation of the distal growth of the grafted piece. The forked condition of the spinal cord is, however, a rather rare occurrence, and especially so in the absence of a forked notochord.

CASE 5.—In this instance both constituents were *R. palustris*. In preparing the larvae for grafting the tails of both were amputated obliquely, so that when stuck together the axes of the two, instead of being in a straight line, met at an angle of about  $135^\circ$ . The two were kept united for six days, and at the expiration of this time it could be seen that the notochord of one had regenerated ventrally, having grown out into the ventral fin-fold. Accompanying this new growth of notochord were embryonic muscle-cells and blood-vessels, but no spinal cord. The two larvae were cut apart so that one whose chorda was regenerating was used as the principal larva, to which the inverted tail-stump of the other was left attached. This larva had, therefore, a forked tail from the start. The

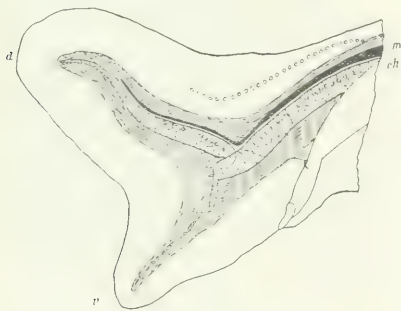


FIG. 18.

CASE 5. Tail, preserved forty-five days after cutting apart: *d*, dorsal fork of tail supported by chorda of grafted piece; *n*, ventral fork of tail supported by regenerated chorda of chief component; *m*, spinal cord; *ch*, notochord; *o o o*, sense organs of lateral line.  $\times 91_2$ .

upper or principal fork was constituted by the transplanted reversed tail, including its notochord, muscle-plates and lastly its spinal cord, which was completely fused end to end with the spinal cord of the principal larva. The outgrowth from the tissues of the principal larva formed the ventral fork of the tail. Both of those branches grew and increased in length and so that shortly after the operation the tail bore a certain resemblance, entirely superficial of course, to the heterocercal

tail of a shark (cf. Fig. 18, Pl. X, which is taken from another specimen treated in exactly the same way). After forty-five days had elapsed, this specimen was preserved and studied as a transparent object (Fig. 18). The notochords had not united. The outgrowth of the chorda forming the ventral fork is of a much smaller calibre than the original part, and presents a wavy or crumpled appearance. That of the transplanted piece is almost normal, but is slightly wavy and ends rather bluntly. It has a length of about 4 mm. Its proximal end is not united to the chorda of the main component, but is bent around ventrally to the side of the latter. The muscle-plates are differentiated as usual. The original ones in the transplanted piece are reversed, while the newly regenerated muscles of this fork present the usual irregularity. This is likewise true of the muscles of the ventral fork, which are undoubtedly derived from cells from both constituents. The fibres of this fork bend around and are continuous with the axial fibres both orally and caudally. The sense organs of the lateral line are continuous out along the dorsal fork, that is from one constituent to the other. The series does not divide, there being none along the ventral fork.

The forked tail in this instance was due no doubt to the fact that the notochords of the two larvae did not abut against each other, thus allowing one the freedom to regenerate. The chance to react in this way was increased by the fact that the axes of the two tails made a considerable angle with each other. This effect is not always the result of these conditions, however, and besides a forked tail may be formed when the two axes are united in a straight line. The length of time during which the two larvae were united is not a factor to be considered in this connection, since in a majority of cases in which the two were united for six days, simple tails resulted, and forked tails were found in several instances where the two larvae were united for but a single day. The irregularities probably arise before the two components are cut apart.

CASE 6. A *palustris* larva was united to a *virescens*. The two were cut apart on the third day, leaving a small portion of the *virescens* attached to the *palustris*. A ventral outgrowth was formed, but in the present case it originated from the transplanted piece and not from the chief constituent as in the previous. The notochord bent around at almost a right angle, and embryonic muscle-cells derived from both constituents accompanied the growth of the chorda. The spinal cord took part likewise and became forked; this is rather exceptional. The organs of the lateral line were present in both forks. In this case, therefore, both forks were derived from the transplanted piece, and we had here the tissues of this piece growing and regenerating from both ends simultaneously, but the resultant tail was not as efficient an organ functionally as any of the cases described above. There is no essential difference in the origin of the irregularity in this case and in the last, for in both the regeneration had undoubtedly begun before the larvae were cut apart. The difference lies in the manner of cutting apart, but it is only in the present instance that we have one and the same notochord regenerating from both ends.

CASE 7. Both constituents were *R. palustris*, and were cut



apart the day after they were united. On the twenty-third day after cutting apart the specimen was killed. At this time the tail had attained a length of 5 mm. The regenerated part was 4 mm. long and was regenerated from the tail of the principal larva, being very nearly straight and normal. The transplanted piece formed but an insignificant hump on the left side of the dorsal fin-fold, and was attached to the muscle-plates on the dorsal side. Neither the notochord nor the spinal cord was fused with the corresponding structures of the principal. No appearances of regeneration were present in either.

The following summary is an attempt to classify the various forms resulting from the same operation as described above. The frequency of each is also given:

I. Simple tails were regenerated from the cranial pole of the transplanted piece. Twenty-six instances.

a) The notochords of the two constituents were completely fused. Two instances (possibly three).

b) The notochords were partially fused. Two instances.

c) The muscle-plates and spinal chords respectively, were fused, but the ends of the notochords merely abutted against each other and were united by connective tissue, the resulting regenerated tail being less perfect than in a). Twenty-two instances.

II. Double regeneration took place, resulting in forked tails. Ten instances.

a) This was due to the regeneration of the notochord and muscle-plates of the principal constituent. Five instances.

b) This was due to the growth of the tissues of the transplanted piece from both ends. Two instances.

c) Both nerve-cord and notochord were forked. Two instances.

d) Nerve-cord alone was forked. One instance.

III. No perceptible regeneration of any kind took place. Three instances.

IV. Regeneration took place in the tissues of the principal constituent alone. The grafted piece, which was but imperfectly united in the first place, remained as an insignificant mass at the side of the newly regenerated tail. Seven instances.

#### B. Tail Grafted to Various Parts of the Body.

CASE 8. A small piece (including yolk as well as integument) was cut out of the ventrolateral body-wall of one

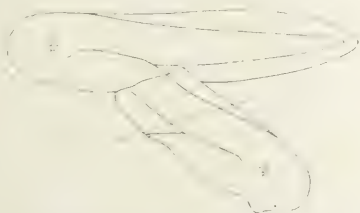


FIG. 19

CASE 8. Three days after operation, showing cut made in separating the constituents.  $\times 8$ .

larva, while the tail-bud was removed from another, and the two were stuck together by the cut surfaces. Both were larvae of *R. palustris*. They were cut apart after three days (Fig. 19). A week later the tip of the reversed tail had rounded itself off and a considerable amount of regeneration had taken place. Connection was established with the circulatory system of the principal larva, and a lively circulation was going on in the transplanted piece. This specimen was preserved on the twentieth day after cutting. The regenerated part of the reversed tail was a little over 2 mm. long. Both notochord and muscles with a well marked fin-fold had regenerated, but the spinal cord had not (Fig. 20). The mode of



FIG. 20.

CASE 8. Tail portion of Fig. 19 *a*. Thirteen days after cutting apart. *t*, tail of principal; *u*, regenerated tail-like structure; *ch*, notochord; *m*, medullary cord.  $\times 8$ .

innervation of the grafted tissue could not be made out with certainty. Numerous sense organs, like those of the lateral line, but rudimentary and irregularly arranged, were present in the epidermis, but no nerves could be traced running to them.

CASE 9. Operation was the same as in case 8, except that the two were cut apart after one day. The regeneration was not quite so regular in this instance, and the nerve-cord of the grafted tissue seems to have contracted or atrophied partially instead of having regenerated. There was, of course, no connection between it and the cord of the principal larva.

CASE 10. A small cut was made in the dorsal fin-fold and muscle-plates of the body of one larva, extending about to the level of the spinal cord. The tail was removed from another and the two united. They were cut apart after four days, so that the reversed tail was left sticking to the back of the other larva. This grafted piece began to regenerate from both ends, the caudal end bending around so as to grow out freely instead of into the substance of the principal larva. Considerable growth took place from each end, but more from the oral than from the caudal (Fig. 19, Pl. X). This specimen was preserved after the expiration of four months and a half. It could be seen in the cleared object that only the muscles and notochord of the grafted tissue had regenerated. The nerve-cord had not. Large cutaneous nerves extended from the principal larva out into the regenerated part of the transplanted piece.

In a few cases tail-buds, not reversed, were transplanted to other parts of the body. Unfortunately, but two of these (Cases 11 and 12) were successful. In both of these the

supernumerary tail was fastened in the midline of the back of the other larva. In both cases the supernumerary tail grew and differentiated at first, but in neither was it ever used in swimming, although it was sensitive to stimuli. After a time atrophy ensued in one (Case 11) and the unused appendage was partially resorbed (Fig. 22, Pl. X). In the other (Case 12) the extra tail retained its normal form much longer (Fig. 21, Pl. X), although microscopic examination of the hardened specimen (preserved three months and a half after the operation) showed that both medullary cord and muscle-plates were involved in atrophy. The peripheral nerves, for the great part at least, originated from the principal larva.\*

#### *Discussion of the Material.*

Complete as is the union in the great majority of instances between the muscle-plates and spinal cords respectively of the two components, perfect fusion of the notochordal tissues was found in but two cases, and possibly in a third. It was in these instances that the regeneration of the reversed part took place in most perfect form and almost as rapidly as regeneration from the caudal end. Where only partial fusion of the notochords occurs, which was observed in three cases, there may be considerable irregularity in regeneration. In one of these specimens there was an actual branching of the chorda to one side.

In the great majority of cases there is no actual fusion.† The notochords of the two components are merely bound together by their connective tissue sheaths. In many such instances regeneration from either of the approximated ends is prevented, but a new growth is provided for at the distal end of the transplanted piece, though it does not take place quite so quickly nor is it so complete as when the notochordal tissue of the two constituents is completely fused. The organ which results in these cases, even if the nerve-cords and muscle-plates respectively be united, is less perfect than the tail described in Case 1.

It often happens that the two notochords do not abut fairly against each other, or are so loosely bound together that one of them has the opportunity to regenerate. This begins before the two components are cut apart, and continues after cutting, no matter whether the regenerating chorda belongs to the main larva or to the grafted piece. Since the grafted chorda grows from its present distal end also, a forked appendage results, the two forks being usually in the same sagittal plane, at least in cases where the muscle-plates are properly fused. In such cases the new outgrowth of chorda is always accompanied by muscle tissue, blood-vessels and by some nerves, but usually not by the spinal cord. The two portions

of the latter unite so readily and exactly that there is but little chance for budding of the chord to take place from the region where the two components are joined. Such a bifurcation, however, occurred in some instances, three in all, and in one of these there was no forked notochord to support the secondary outgrowth. It is possible that the collection of cerebro-spinal fluid at the point where the two components are joined may give the first impulse to the outgrowth which results in the branch.\*

If the union of the two components is so imperfect that neither the notochords nor the spinal cords are fused, and especially if the displacement be from side to side so that the corresponding muscle-plates do not join, then the tissues of the principal larva, being free to grow, begin to regenerate rapidly and soon outstrip the feeble growth from the distal end of the transplanted piece.† A new complete tail is thus formed from the principal larva; the grafted piece ceases to grow and remains as a hump on the side of the new tail.

When a reversed tail is healed to another part of the body of another larva, considerable regeneration takes place in both muscles and notochord. A tail-like organ is produced with a well-developed fin which is rounded at the end, but which is crumpled more or less. The spinal cord in these cases does not grow, however, and indeed it may be said that in all cases where the grafted cord remains isolated from that of the principal, it persists in a rudimentary condition or may even almost entirely degenerate.

These experiments establish beyond a doubt the fact that the regenerative power of the tissues of the tail is very considerable in both directions. The appearances of regeneration observed by Born in the oral ends of isolated tails are the mere beginning of what is possible, provided that sufficient nutrition is supplied and functional activity afforded. That the latter is an important factor, is shown by the contrast between reversed tails implanted in the natural position and those attached to parts of the body, such as the abdominal wall, the back or the side of the tail, as in Case 7, where they may only remain passive.‡

\* These cases of forked tails are analogous (the ends being reversed) to those found in some instances by Joest (12) when the tail pieces of two earthworms were joined together by their oral poles. In seven such cases Joest found that heads regenerated at the place of union. In six of these but one head was formed, while in the seventh two were regenerated (l. c., page 488). Similarly in Hydra, Wetzel (26) found that when two decapitated individuals were joined together by their oral ends, mouth and tentacles were formed at the place of union and the two individuals ultimately separated.

† Born (page 396) records a case in which the muscle-plates of the left side of the anterior component pass continuously into those of the right side of the posterior component. I have found several similar cases in the above series.

‡ Of interest in this connection are the experiments of Barfurth (1) bearing upon the functional adaptation of regenerating parts. The tails of a number of tadpoles were amputated obliquely. The axis of the regenerated tail, which is at first perpendicular to the plane of the cut, righted itself in time in all cases, but in those individuals which were permitted to swim actively, this adjustment took place much more quickly than in those subjected to enforced quiet.

\*In a case which Born described, a tail transplanted to the ventral body-wall disappeared down to a small stump in the course of time. In my attempt to repeat this operation I was unsuccessful.

†This has already been observed and commented upon by Born (page 394), who calls attention to the relative rigidity of the chorda even in early stages, and to the fact that the cut ends often project beyond the surface of the cut, as probable factors in preventing direct union. It may also be mentioned that there is but a relatively small quantity of yolk in the notochord at this time, and that it is by far the most highly differentiated of the tissues of such young embryos.

In the intestine the regenerative capacity is but slight in either direction, but the power of self-differentiation is exceedingly well marked. This is shown in the persistence of small masses of endoderm which were cut off along with the reversed tail-stumps in several instances. These bits of yolk not only maintain their individuality for weeks, but also differentiate into miniature intestines with mesentery, blood supply and surrounding body-cavity; and this, even though functional activity is entirely excluded.\*

As far as the histogenetic processes are concerned, there is but little difference between the mode of regeneration from the cranial and the caudal ends. For the purpose of investigating this matter a number of regenerating reversed tails were cut into serial sections.

The growth and histological differentiation of the notochord takes place just as in normal cases, beginning as a solid outgrowth of closely packed cells, which form a rod much more slender than the old chorda. Vacuolization of these cells takes place later.

The spinal cord rounds over the cut end. On the side of this, groups of ganglion-cells make their appearance, and from there a pair of regenerated nerves eventually passes to the periphery. Subsequently some of the ganglion-cells move out along the nerve-root (see p. 179). These processes take place considerably more slowly than when the regeneration goes on from the caudal end, and of course irregularities often arise.

The muscle-fibres which were injured in cutting the two larvae apart begin to break up, and traces of disintegrated fibrils may be found for four or five days. At the end of this time a layer of embryonic muscle-cells (sarcoblasts) extends from the uninjured myotomes to the tip of the newly regenerated notochord. Thus far the process is just as it takes place in ordinary regeneration. When fibrils are differentiated, however, the bundles do not become arranged into distinct muscle-plates (cf. page 182), but are more or less irregular (Fig. 14), while in tails regenerated from the caudal pole the arrangement of the muscle fibres assumes the same form as in the primary appendage. Obviously, there are several disturbing elements which bring the irregularity about. The muscle-plates directly adjacent to the newly regenerating muscles are reversed, and their contours must have some influence upon the arrangement of the newly differentiated fibres. On the other hand, the position of the latter as regards the tail as a whole is the usual one. The result is what might possibly be termed a compromise. The new groups of muscle-fibres become arranged neither according to their original orientation nor according to their new position with respect to the whole organism. There is a tendency, however, vague as it may be, for the more distally placed fibres, that is, those considerably removed from the influences of the old muscle-plates, to be arranged into quasi-

myotomes with the angle of the V pointing forwards as in the usual form; but the explanation of this cannot be made clear until it is understood why the myotomes have this V-shape in all Ichthyopsida.

The question stated at the beginning of this section (page 180) now comes up for consideration. Are these cases to be regarded as examples of heteromorphosis, or not? Especially regarding such cases as Case 1, one is at first inclined to answer this question in the affirmative. In place of a trunk and head, which have been removed, there arises a tail-like appendage, which is an organ both structurally and functionally different. Loeb's definition is apparently complied with.\* Regeneration from the original caudal end of the tail-stump was prevented by implanting that end into the tissues of another individual. The surrounding conditions of the two ends of the grafted piece are reversed and the outcome is much the same as in the case of *Tubularia*,† where sticking the oral end of a bare stem into sand prevents a polyp from being formed there, while the aboral end, being free to grow, does produce a hydranth. In the case of the reversed tail the said change of surrounding conditions consists in a change of relation with regard to the rest of the organism. We would thus have a case of heteromorphosis, brought about through functional adaptation to the needs of the organism as a whole.

But on closer examination a simpler interpretation of the phenomenon becomes possible. An inquiry into the grounds for calling the regenerated appendage a tail shows that while there is a striking resemblance in external form and in the arrangement of the various component parts, this similarity may be explained by taking into account the details of the regenerative processes. The notochord is merely a straight rod, lacking visible differentiation of its elements in a cranio-caudal direction; it is, therefore, not remarkable that its growth, whether proceeding from one end or the other, should take place in the same manner and give the same results. Much the same might be said of the blood-vessels. The spinal cord of the tail is in any case a rudimentary organ. The course of the peripheral nerves is explained by the shifting of the epidermis known to take place during development. In the only tissue in which there is normally a plainly visible orientation of the elements, viz., the axial musculature, the arrangement of the fibre bundles in the reversed tail is not as in a normal tail, either primary or regenerated, but is irregular. Moreover, when it is considered that the tail of a tadpole differs from the trunk in the absence of certain characters, and only to a small extent in the presence of distinguishing ones, such as the fin-folds, it becomes apparent that the tail-like organ above described is not much more than what might be called an imperfectly regenerated trunk.

Thus the cases under discussion, even such as Case 1 and Case 3, lose much of their significance as examples of heteromorphosis. At most they might be regarded as heteromorphic appearances by virtue of purely negative characters, but

\* Born brings forward many facts which indicate the high power of self-differentiation in the tissues of frog embryos at the period when grafting is performed. He concludes (page 613): "Die Entwicklung entspricht also von unserem Ausgangsstadium an durchaus der Mosaiktheorie Roux's; die organbildenden Keimbereize sind ausgetheilt (His)."

\* Loeb (14) who proposed the term heteromorphosis defines it (page 10): "Die Erscheinung, dass bei einem Thier an der Stelle eines Organs ein nach Form und Lebenserscheinungen typisch anderes Organ wächst."

† Loeb, page 12.



better and simpler is it to call the phenomenon incomplete regeneration.

This interpretation is strongly supported by the second series of experiments, in which reversed tail-stumps were implanted to various parts of the body (Cases 8-10). Even in these instances a by no means inconsiderable amount of regeneration occurs, and the structure produced is not unlike a tail, for it possesses all the constituents of such, including well marked fin-folds,\* and this takes place, although the possibility of functional adaptation to the purpose of locomotion is eliminated, and no tail is necessary to complete the organism. The effect which the position of the regenerating appendage produces is merely difference in degree of perfection. The more perfect appendage is produced when all of the constituent parts (chorda, musculature and spinal cord) of the transplanted piece are in union with the corresponding parts of the main component, i. e., are in quasi natural relations, so that they may enter upon the ordinary exercise of their function in co-ordination with the organism as a whole.

While it must be recognized, therefore, that functional activity is an important factor in regeneration, as indeed, for the ordinary welfare of a part already developed, it is of importance only to the extent that it brings about a higher degree of efficiency in the structure already capable of considerable independent development in a given direction, regardless of surrounding conditions. The present experiments do not justify us, however, in going further, in the conclusion that unusual relations imposed upon a regenerating part call forth out of material which would normally be used otherwise, an entirely new heteromorphic structure, as a functional adaptation to new surroundings, or as the result of a striving to complete the mutilated organism.†

\* Only the spinal cord fails to regenerate, but this is always the case when the grafted portion fails to unite with the central nervous system of the main component.

† Analogous experiments upon other animals give likewise no firm support to the view that heteromorphosis may be brought about through functional adaptation. Morgan's (17) experiments upon earthworms (*Allolobophora fetida*) give, as far as they go, a negative answer. In the experiments in question the posterior portions of two worms were sewed together; from one of these the tail was amputated. In all cases where regeneration took place tails were formed, i. e., the part which was cut off, not the part necessary to complete the organism and render it capable of further existence.

Wetzel (27) has made similar experiments upon *Hydra*. He united the oral portion of two polyps by the aboral end, and thus obtained a double individual; one head was afterwards cut off and in place of this a foot regenerated (page 71). This result is the opposite of Morgan's. Wetzel interprets this as a case of heteromorphosis (page 83), but in view of the small number of instances in which such results were observed, he is not willing to ascribe its occurrence to the influence of the uncut component upon the regenerating one. But even against regarding the case in question as heteromorphosis at all, there are objections, for it is not impossible that during the time elapsed between amputation and regeneration the whole of the mutilated component may have been absorbed down to the aboral end of the other component, from which, then, the foot might have been produced in the normal way (cf. Nussbaum, 20, page 12). Unfortunately, Wetzel

Coupled with the occurrence of heteromorphosis is the question of the polarity of the organism. Unfortunately, the term "polarity" is used with many different shades of meaning. Fundamentally a purely geometrical conception, it signifies more when used by the morphologist, implying not only symmetry, but also an internal cause for that symmetry, by virtue of which every particle of the organism has the same polar relations as the whole. This conception is based upon facts gathered from the study of regeneration, which show that the smallest possible part of an organism capable of regeneration maintains the same orientation as the whole, from which it was cut. For example, in *Hydra*, a head regenerates from the oral end of a fragment, and a foot from the aboral end, when the fragment is left under ordinary conditions.\*

By imposing various external conditions upon regenerating organisms the polar relations may be modified, but it seems scarcely justifiable to conclude that such facts do away with the polarity of the organism concerned; certainly, no more so than to maintain that the fact that the poles of a magnet may be reversed by the influence of a more powerful magnetic force, does away with the polarity of the magnet.

Nevertheless, it is perhaps unfortunate that the word "polarity" should be used in connection with the living substance, for in that case one involuntarily assumes the occurrence of phenomena of attraction and repulsion with protoplasm as the basis. At least as far as animals are concerned there is no indisputable evidence in favor of this assumption. Obviously, it may be tested best by means of grafting, whereby tissues differently oriented may be brought into organic

records in his paper no observations controlling this possibility. Should this objection prove to be unfounded, it still remains that the sole positive character which serves as a basis for calling the phenomenon heteromorphosis, viz., the presence of gland cells in the newly formed foot, is by no means a good criterion. The difference between the gland cells and the epithelio-muscle-cells is only one of degree. Nussbaum (19, page 278) has shown that all of the epithelio-muscle-cells contain secretory granules, the gland-cells of the foot simply containing more. And further, in buds, transitional stages between the two kinds of cells are found at the place where the new foot is to be formed, i. e., muscle-cells are here directly transformed into gland cells in the course of ordinary budding.

\* This is expressed more clearly and categorically in the oft quoted words of Nussbaum (19) as follows: "Ausserdem müssen wir zur Erklärung der Erscheinungen bei unseren Versuchen noch die Annahme machen, dass die Zellen wie in den Funktionen auch in der Struktur, in dem Aufbau ihrer kleinsten Theile hoch differenzirt seien, dass nämlich innen und auszen, vorn und hinten nicht allein an dem ganzen Individuum ihre volle Geltung haben, sondern dass die axialen Orientirungen des Individuums in den Orientirungen seiner kleinsten Theile begründet seien. Es muss also in jeder Zelle ein Vorn und Hinten, ein Innen und Auszen geben, rechts und links sind dadurch von selbst bestimmt . . . und da jede Zelle weiterhin theilbar gedacht werden muss, diese axiale Orientirung auch an den kleinsten Theilen der Zellen schon vorhanden sein" (page 348). As is also seen from a later publication, Nussbaum (20) intends the above to apply only to cells already differentiated.

continuity.\* Even then, disturbances arising in such unions may be due to a variety of causes, such as the reversal of structural relations upon which the exercise of normal functions are dependent,† and are not to be compared off-hand with the repulsion of like poles of magnets. Thus, the irregularities resulting in the reversed-tail experiments, where two caudal poles are placed in juxtaposition, may be traced to the circumstance that two regenerative centres are brought together.‡

The only phenomenon which might be interpreted as the expression of some general organic disturbance resulting from abnormal polar relations, is the degeneration which set in in some of the reversed tails, as in Case 3. Also in Case 1, where the tail regenerated from the cranial pole was so perfect, indications of degeneration could be made out which involved both epidermis and the axial musculature. But no conclusion can be drawn from these in the absence of careful controlling experiments. Even should it turn out that the degeneration were due to abnormal position of parts, it could not be shown that there is any resemblance to magnetic repulsion.§

#### V. REACTIONS BETWEEN TISSUES DERIVED FROM DIFFERENT SPECIES.

Partly as a result of the experiments described in the second section, there were obtained a number of larvae of normal external form, but which were composed of parts derived from two distinct species. Many of these were kept under regular observation for a considerable length of time, in some cases

\*That the union of such differently oriented parts is easy to accomplish is manifest from all the recent experiments in the transplantation of animal tissues as is seen from the results of Born, Wetzel, Joest, Morgan and myself.

†This is admirably illustrated by Mall's (16) experiment in reversing a coil of intestine in the dog. The reversed coil heals perfectly with the non-reversed part, but the peristaltic movement takes place in it as if it had never been tampered with. The heaping up of the intestinal contents at the suture eventually results in the death of the animal.

‡This is in substantial agreement with Wetzel (26) who concludes from his experiments upon Hydra: "Dies deutet darauf hin, dass vielleicht weniger polare Gegensätze als überhaupt Abweichungen von der normalen Gestalt die beschriebenen Vorgänge bedingen." In his second paper, Wetzel (27) distinguishes between "Regenerationspolarität" and "Verwachsungspolarität." While these expressions do not seem to me to be quite apt, the distinction made above by me agrees essentially with Wetzel's.

§Vöchting (92) on the other hand, from his elaborate study of plant-grafting comes to the conclusion that the polarity of the vegetable cell is comparable to the polarity of the magnet. In the theoretical discussion of his results he states (page 156): "Wohl waren wir im Stande, den Gegensatz der Pole dadurch festzustellen, dass wir die gleichnamigen und ungleichnamigen in Berührung brachten und dadurch zu der Regel gelangten, dass die ersteren sich abstoszen, die letzteren sich anziehen,—ein Anziehen und Abstoszen, das sich hier freilich nicht in freien Bewegungen, wohl aber im Wachstum äussert. Wir verfahren sonach ganz wie der Physiker, der die Eigenschaften der verschiedenen Pole des Magneten auch dadurch bestimmt, dass er sie auf einander wirken lässt."

for three or four months after the absorption of the food yolk.\* The general biological interest attaching to such heteroplastic combinations is naturally great. The reactions between the tissues of distinct species, when united into one organism, deserve careful study. Unfortunately, the present material is far from adequate, but certain observations were made which seem to be of importance. These are here recorded in the hope that they may be supplemented at no late date.

First to be considered are those larvae in which the tail-bud alone was transplanted. In this combination the tissues of the one species greatly preponderate over those of the other. The grafting of the tail by itself is such a light operation (succeeding in about four cases out of five) that few abnormalities ever result therefrom. The larvae, at least at first, are perfectly normal and are as healthy and as active as any which are born in freedom and not experimented upon. The usual development of blood-vessels takes place in the tail, with the subsequent incorporation of these into the general circulatory system of the individual. The blood begins in time to flow freely from the body to the tail and back again to the body. Both parts are at first equally well nourished and grow commensurately, so that the usual aspect of the tadpole is not changed (Fig. 6, Pl. X). The body-constituent does not immediately cast off the transplanted tail and regenerate a new tail of its own species, but the latter persists even though it is of a different species, and affords a perfect substitute for the one replaced.† The tail preserves, moreover, in a general way, its specific characters even after months have elapsed, so that one who is familiar with the markings of the respective species would have no difficulty whatever in distinguishing grafted specimens from normal ones.‡

\*Born made extensive experiments in combining larvae of different species or even genera, as in the case of *Rana esculenta* and *Bombinator igneus*. Owing, however, to unfortunate circumstances, none of these combined specimens survived the operation much over three weeks.

†This is different from the result which Wetzel obtained from grafting together hydras of different species (*grisea* and *fusca*). In this case, even though there be a union between the two parts, each part completes itself by regeneration of what is missing. But when the two pieces (similarly oriented of course) are of the same species, no regeneration occurs, for then the two unite into one complete individual. Wetzel calls attention (page 88) to the difference between his results and Born's, who found no regeneration from either when two pieces of different species were joined. His objection to the comparison between the results in Hydra and the Amphibian embryo, viz., that in the latter scarcely any regenerative capacity is present (referring of course to the trunk-region), would not hold in the case of my experiments with the tail, where the power of regeneration is very great. But then, as Wetzel points out, the union between pieces of hydras of different species is never complete and the one part does not react to stimuli applied to the other. Therein seems to lie the chief ground for the difference between his results and Joest's (*Lumbricidae*), with which latter mine agree in essentials.

‡The specific markings in later stages are due to the presence of large chromatophores, situated for the most part in the tissues underlying the epidermis. It seems certain that such cells often cross the boundary for a short distance from one species to the other, although it is difficult to demonstrate this actually, since the



The regenerative power of the transplanted tail is also normal as is seen from the following experiment:

CASE 13.—The tail of a larva of *R. virescens* was replaced by the tail of a larva of *R. palustris*, in the manner described above (page 175). Forty-eight hours later, at which time the sketch (Fig. 21) was made, the tail was amputated. The epidermis from the virescens body had then pushed out considerably over the root of the tail, so that in cutting almost all of the grafted epidermis (stippled in the figure) was removed. But a considerable portion of the underlying organs of the transplanted piece (shaded in the figure) remained, and it was from this component that regeneration took place in all the tissues with the exception of part of the epidermis. The newly grown tail was of normal form; and, as far as could be observed, it had the characteristics of the species of the grafted stump (*palustris*) and not those of the body (*virescens*) (Fig. 4, Pl. X).



FIG. 21.—*Rana virescens* with tail of *Rana palustris*, two days after transplantation, showing place where tail was amputated.  $\times 11$ . For regeneration see Fig. 4, Pl. X.

This was seen in the character of the pigmentation and especially in the absence of the large black blotches along the side of the tail, which are found constantly in the regenerated appendages of *R. virescens*. In spite of the insignificant size of the grafted stump as compared with the whole body, and in spite of the fact that the nourishment conveyed to the growing appendage is brought there in blood which is largely derived from the body, the tissues maintain their specific characters.\* (See foot-note page 191.)

A number of specimens in which each of the two components formed approximately equal parts of the individual were kept under observation. In all the cases in which this combination resulted successfully, *R. virescens* had been used as the head component and *R. palustris* as the caudal. Although the reciprocal combination was tried in a considerable number of instances, for some unknown reason it never resulted in success. The *palustris* embryo being somewhat larger than

markings are referable to characteristic groupings of the pigment cells rather than to differences between the individual elements of the two species. These circumstances are unfortunate for the present purpose and conspire to add a source of error in the interpretation of observations.

\*I had hoped to obtain more definite evidence concerning the influences which regulate regeneration, from experiments carried out upon these lines. But owing to unfortunate circumstances most of the larvae of this series died. Besides, all regenerated tails deviate somewhat from the normal type, especially as regards pigmentation, which fact would bring in a considerable element of uncertainty, and in the tail I have not been able to find any other characters which could with safety be considered diagnostic of either species.

the other, it was found advisable to cut off the head of the former in the constricted region just behind the gill arches, while the latter was cut somewhat further back where its circumference is greater. On this account at least part of the pronephros and possibly also the rudiment of the fore leg were duplicated, but without disturbing effect.

Many of these larvae (nearly thirty) gave promise of doing well. They passed through the critical stage when the supply of food-yolk is exhausted, and began to eat and to shift for themselves. All of them showed the characteristics of *R. virescens* in the head and those of *R. palustris* in the body and tail. However, no sharp line dividing the two constituents could be observed after the yolk and ectodermal pigment was gone (Fig. 5, Pl. X).

One by one they became weakly, decreasing considerably in size and finally dying unless preserved. Several of these larvae lived over three months; the others succumbed at various intervals.

Only one (Fig. 5, Pl. X) passed through its metamorphosis. The operation in this case was performed on April 6. In its larval history there is nothing of individual importance to note. On August 7, its forelegs broke through. Its metamorphosis was completed on August 10. The resulting frog, perfectly normal in form, was much smaller than usual, being but 1.7 cm. long.\* It was kept in a terrarium in which it had access to a pool of water. Its instincts were apparently normal, and it would spring about catching small flies and other insects, which were supplied in abundance. On August 27 it died suddenly, death being probably due to overfeeding. The specimen was placed in formalin a few minutes after death ensued, and was afterwards photographed (Fig. 25, Pl. XI), magnified approximately two and a half diameters.

The little frog is darker than any of the specimens of either *R. virescens* (Figs. 23 and 24, Pl. XI) or *R. palustris* (Fig. 26, Pl. XI) which I have examined.† The trunk has distinctly the markings of *R. palustris* with the dark-brown squarish spots on the back arranged in two rows on a lighter field, which, in the present case, is much darker than usual.‡ The spots are relatively larger than in the normal *palustris*, although I have had no specimen which was as young as this for comparison. Both pairs of legs correspond to the *palustris* type in the arrangement of the tubercles as well as in the markings of the skin.§

The head does not seem at first to resemble that of the normal *virescens* very strikingly. The snout is much too blunt and the distance between the eyes too great. These are, however, characteristics of the young individual. The unusual protrusion of the eyeballs is a post-mortem change. There is one round spot in front of the *palustris* region, and this is a *virescens* marking, and the characteristic spot on the top of

\*The larvae of *R. virescens* do not usually complete their metamorphosis until the following season.

†For descriptions of these species, see Cope (5).

‡The dark color has been considerably exaggerated in the figure, so that the markings on the body hardly show.

§In grafting, the rudiment of the anterior extremity was left intact in the posterior (*palustris*) part, and at least part of the rudiment was left in the anterior (*virescens*) component.



the orbit is present, though not very well defined. The lines running from the nostrils to the eye and to the shoulder are not very distinct. But what is more important than these color-markings, the arrangement of the vomerine teeth is like that in *R. virescens*. It was observed too that, especially in the virescens part, the characteristic markings made their appearance little by little. Had the frog lived longer, it does not, therefore, seem improbable that this part would have become more virescens-like. At any rate, the deviation of the head from the normal virescens type is not in the direction of the palustris type. And a similar statement may be made with regard to the body, for its general darkness in color can scarcely be regarded as a virescens character. Each component, then, maintains, on the whole, its own specific characters, subject, however, to certain non-specific modifications, as in the cases where the tail alone is transplanted. Of course the blood derived from the two parts is completely mixed and there is beyond doubt an interlacement of nerve-fibers both in the spinal cord and peripherally. A portion of the palustris component is covered over by virescens epidermis (page 177) and the virescens nerves running to this region must pass through the connective tissue of the palustris constituent. Wandering cells, pigmented and otherwise, no doubt cross the border from one component to the other. But all of these occurrences are found in the development of the normal individual, and are of the nature of the mixing of tissue-elements, rather than a blending of their characters. In addition to this, the tissues of the two species undoubtedly may influence one another in various ways, as is well known in the case of plants. A discussion of these influences in the absence of more material would be premature. It will suffice here to repeat that the two components do not modify one another in the direction of their respective species.\*

Notwithstanding the fact that the grafted appendages described in the beginning of this section are nourished and grow normally at first, their later history, as seen from the description of the following individual cases, seems to indicate

\* This is in agreement with the conclusions reached by Vöchting (24) from a study of plant-grafting. After summing up the various influences of stock upon scion he concludes (page 112): "Zu den genannten drei Gruppen von Einflüssen werden sich, wenn ihre Existenz erwiesen wäre, als vierte die gesellen, welche als spezifische unterschieden werden mögen. Das Eigentümliche ihrer Wirkung würde darin bestehen, dass sie Veränderungen in der spezifischen oder systematisch gegebenen Form hervorriefen, somit also von sehr tiefgreifender Art wären. — Derartige Einflüsse, angeblich zwar oft beobachtet, haben sich bei näherer Untersuchung in der Regel als Täuschungen erwiesen. Uns selbst ist es in keinem unserer zahlreichen Versuche gelungen, ihre Wirkung wahrzunehmen. — Durch solche Einflüsse wurden auch die sogenannten Pfropfhybriden hervorgerufen, deren Existenz aber, wie früher ausgeführt, durchaus zweifelhaft ist."

Also Joest (12), who made numerous successful experiments in uniting earthworms of different species and genera, obtained like results. In all heteroplasmic combinations each part was found to preserve its specific characters, coloration included, even down to the minutest observable details. And even in cases where one of the components regenerates a lost part, no influence upon the regenerated part could be traced to the component of the other species.

that the harmony between the tissues of the two components is not permanent.

CASE 14.—A tail of *R. virescens* was grafted in normal position to the body of a palustris larva. The operation was performed on April 27th, the union of the parts being very exact. On May 20th, twenty-three days later, signs of degeneration were observed in the tip of the transplanted piece.\* The degeneration was at first confined to the tip, and was apparent as a slight shrinking of the tissues of the fin-fold at that place, so that the distal end of the notochord projected freely beyond, as may be seen in Fig. 7, Pl. X, which is taken from Case 16. After this, atrophy proceeded very rapidly, although not so rapidly as during normal metamorphosis. On May 31st, eleven days after first being noticed, almost the whole of the transplanted tissue had become involved in the degeneration (Fig. 8, Pl. X). At the time degeneration began, and even after it had proceeded so far, the hind extremities were represented by the merest knob-like projection on each side of the base of the tail. No metamorphosis followed the resorption of the tail. Degeneration was confined exclusively to the grafted tissue, and involved eventually the whole of it, although it was never entirely absorbed. The larva was apparently well nourished and grew rapidly, though its appearance was rather grotesque owing to the curious shape of the remains of the tail (Fig. 9, Pl. X). On July 28th the specimen was preserved.

CASE 15.—This has a history almost exactly similar to the foregoing. The atrophy of the tail was somewhat more complete (Fig. 10, Pl. X).

CASE 16.—The combination was the same as in the foregoing. The operation was performed on April 21. As in the previous cases degeneration began early, but did not proceed beyond the initial stages (Fig. 7, Pl. X) until several months had elapsed, but instead the tail grew to an unusually great length. The grafted part in which the blood supply was excessively rich, was distinctly marked off from the root by the smaller size of the axial musculature (Fig. 11, Pl. X). On July 26 a sudden change was observed in the tip of the tail, which then became very deeply pigmented. Examination with the microscope showed that the blood-vessels throughout the tail were distended, and that the circulation in them had practically stopped. At this time the hind legs were fairly well developed, although by no means advanced as is usual at the time of metamorphosis. Degeneration with absorption of the tissues proceeded rapidly, but the specimen was preserved two days later before the process was completed.

CASE 17.—In this case the reciprocal experiment was performed. A palustris tail was transplanted to a virescens body. The grafting was done April 13. Not until May 31 were any signs of degeneration noted (Fig. 12, Pl. X). Atrophy of the tail proceeded with but little apparent resorption of the tissues, so that six weeks later the appearance of the larva in gross was quite different from either of the others just described (Fig. 13, Pl. X). The axis of the tail was considerably shriv-

\* In the history of a composite specimen where the tail half of a larva of *Rana arvalis* had been transplanted to the belly of a larva of *Rana esculenta*, Born mentions that the tail tip of the former showed signs of atrophy after a short time, page 561.

eled but not much shortened. No further changes were noticed between July 15, when the photograph was taken, and August 16 when the specimen, otherwise still perfectly healthy, was preserved.

In addition to the four cases just described, there were others in which the incipient stages of atrophy were noted. Two of these were palustris larvae with virescens tails, and two were virescens larvae with palustris tails.\*

On the other hand there were three virescens larvae with palustris tails which showed no signs of degeneration in the transplanted tissues. One of these, the case described above, in which a portion of the grafted tail was amputated and allowed to regenerate, was preserved ninety-three days after the operation, and the others, when last observed four months after, were perfectly normal.

Likewise, in some of the cases also described in the second section (page 177), where a small portion of the body, including some yolk, was transplanted along with the tail, similar degenerative phenomena were observed. In all, five specimens were kept for forty days or longer. Two of these, both virescens larvae with palustris tails, became weak, seemed poorly nourished, and died at the expiration of forty and sixty days respectively, without showing any particular signs of atrophy of the tail. In two others, which were otherwise apparently healthy, the tail did degenerate. The one to show it the earlier was a palustris larva with a virescens tail, in which degeneration began about the ninety-fourth day after the operation, and proceeded rapidly in much the same way as in Case 1. The other tail, which began to atrophy on the one hundred and third day, was *R. palustris* and had been united to a virescens body. This was never absorbed as in the first case, but had an appearance much like that described in Case 16. The fifth specimen was preserved after four months, and at that time was in a perfectly healthy condition.

These cases may be summed up as follows:

Virescens tails grafted to palustris larvae always degenerate (five cases), while palustris tails grafted to virescens bodies degenerate in fifty per cent. (three) of the cases.

When a small portion of the body, including yolk, is transplanted with the tail, degeneration begins later than when the tail alone is removed.

Two possible causes of the premature atrophy suggest themselves. One is that it is due to the operation of grafting itself, perfect as the union of the constituents may appear.† The other and more probable one is that there is an incompatibility between the tissues of the two species whereby the preponderant one poisons, or at least fails to nourish properly, the

other, in spite of the perfect anatomical relations.\* In favor of this view there is some evidence, even if it is not crucial. In the first place the quantity of the tissue in the smaller constituent is an element to be considered. When part of the body along with a small portion of yolk is transplanted with the tail, degeneration does not begin until very much longer after the operation than in those cases where the tail alone is removed. This occurs in spite of the fact that the former operation involves more vital parts. In the second place, when the palustris tissue preponderates greatly over that of virescens, degeneration takes place in all cases, while in the reverse combination this degeneration does not always ensue, and when it does, it assumes a different form.‡

The further discussion of this interesting question must be postponed until a more systematic series of experiments is made, and above all until sufficient material is at hand for a careful histological study of the degenerative processes.

#### SUMMARY.

1. The embryos of *Rana virescens* and *Rana palustris* are markedly different in color. The specific coloration which is due to pigment and yolk granules, is common to all cells. In heteroplastic combinations of embryos of these species, made according to Born's method, it is, therefore, possible to follow in the living specimen, as development proceeds, the movement of any group or layer of cells with respect to the original dividing line between the two constituents.

2. The combination of body and head of one species with embryonic tail-bud of the other, gives the following information concerning the mode of growth of the tail: a) The epidermis passes steadily from the body to the tail, shifting over the underlying structures, so that one week after grafting the original epidermis of the tail-bud covers but about one-third (the tip) of the tail. b) The musculature, spinal-cord and notochord increase in length largely by apical growth, and also, but to a much less extent, by the pushing of segments (about three) out from the trunk to the base of the tail.

3. In the trunk region, the shifting of the epidermis over the underlying organs becomes less in amount as the head is approached.

4. The movement of the epidermis is due to the tension brought about by the rapid apical growth of the tail, and the absence of a corresponding proliferating centre in the epidermis at the tip.

5. The oblique course taken by the cutaneous nerves of the trunk and tail of the full grown larva and frog, in passing from the vertebral column to their ending in the skin, is due to the ontogenetic shifting of the latter from its original position.

\* In three of these, degeneration was first noted after the specimens had been stained and mounted. They had lived twenty-five, twenty-one and twenty-seven days respectively. In the fourth, signs of atrophy were observed on the twenty-fourth day. A few days later this specimen died from an unknown cause.

† Unfortunately, the atrophy of the tail was not observed until after the material at my disposal for experimentation was exhausted. It was, therefore, impossible to make the simple experiment of transplanting a tail from one individual to another of the same species. This would either have proved or eliminated definitely this first possibility.

\* Disharmonic combinations are well known in plants. See Vöchting (24), page 100. Born (3) also touches upon this question at the conclusion of his paper.

‡ Of interest in this connection are the results obtained by L. Loeb (15) from the study of transplantation of skin in guinea-pigs. White skin transplanted to a black field behaves differently from black skin removed to a white field. The former sloughs off while the latter persists. Loeb traces this to the superior regenerative power of the dark skin.



6. After amputation of the tail, the peripheral nervous system is regenerated from the spinal cord. First, a single nerve pair arises from cells lying within the cord. Part of these cells pass out upon the nerve-root and form a large ganglion. Later, a few of the nerve-cells wander further peripherally along the nerve-trunk, forming several (at most three) ganglionic cell-groups. These represent the more distally situated ganglia, lost in amputation, which are never entirely replaced.

7. The oral end of an amputated tail-bud has a considerable regenerative capacity, when the bud is transplanted by its distal end to the body of another individual. The structure then regenerated is tail-like in form, no matter to what part of the body it is attached.

8. When transplanted so as to replace a normal tail the resemblance to the latter may become striking. The perfection of the part as a swimming appendage is in such cases dependent upon the exactness with which the corresponding tissues of the respective components are united. If the union is imperfect, forked tails result.

9. The cases in question are not necessarily to be regarded as heteromorphosis (tail in place of head and trunk), for the tail-like appendage is to be considered as an imperfectly regenerated trunk.

10. The position of the reversed tail-stump with respect to the rest of the organism is of importance during regeneration, only in so far as it influences the degree of efficiency of the structure regenerated. Neither the present nor other experiments indicate that the influence of the organism as a whole upon the regenerating part is able to bring forth a heteromorphic structure, functionally adapted out of material which would normally produce something else.

11. In combinations between embryos of two species, each component maintains its specific individuality. The modifications which may arise in either of the components are not of the nature of a blending of specific characters.

12. In combinations where the tail alone is replaced by a tail of the other species, the latter forms at first a perfect substitute for the original tail. Nevertheless, in the majority of cases, the grafted appendage atrophies later and disappears almost entirely, long before the larva undergoes its metamorphosis.

13. When a small portion of the trunk is transplanted along with the tail, atrophy of the latter is considerably delayed.

14. Also when the two components are united in the region of the pronephros, the composite larva grows normally and may remain healthy and vigorous for many weeks. Only in one case, however, did such a specimen complete its metamorphosis. The frog had perfectly normal instincts and power of co-ordination. The portions derived from each of the two species could nevertheless be distinguished clearly by means of color-markings and other specific characters.

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#### EXPLANATION OF PLATES.

##### PLATE X.

(All photographs taken from the living tadpoles.)

Fig. 1. *Rana virescens*, normal with the exception of the tip of the tail, which is regenerated.  $\times 2$ .

Fig. 2. *Rana virescens*, with regenerated tail.  $\times 3\frac{1}{2}$ . Note deepness of pigmentation of the tail, especially the large blotches.

Fig. 3. *Rana palustris*, normal.  $\times 2$ .

Fig. 4. Case 13. *Rana virescens*, with tail of *Rana palustris*, which is for the greater part newly regenerated.  $\times 3$ .

Fig. 5. Head of larva (including gills) *Rana virescens*, remainder *Rana palustris*. Photograph taken one hundred days after operation.  $\times 2$ . Same individual as frog (Fig. 25).

Fig. 6. *Rana palustris*, with tail of *Rana virescens*. Twenty-seven days after operation. Scarcely perceptible signs of atrophy in tail-tip.  $\times 3\frac{1}{2}$ .

Fig. 7. Case 16. Same combination as Fig. 6. Forty days after operation. Tip of fin-fold atrophied.  $\times 3\frac{1}{2}$ .

Fig. 8. Case 14. Same combination as Fig. 6. Thirty-five days after operation. Degeneration of transplanted tail, much further advanced than in Fig. 7.  $\times 3\frac{1}{2}$ .

Fig. 9. Case 14. Seventy-seven days after operation.  $\times 2\frac{1}{2}$ .

Fig. 10. Case 15. Same combination as the foregoing. Eighty-one days after operation.  $\times 2$ .

Fig. 11. Case 16. Eighty-three days after operation.  $\times 2\frac{1}{2}$ .

Fig. 12. Case 17. *Rana virescens* with tail of *Rana palustris*. Forty-eight days after operation (cf. Fig. 7).  $\times 3\frac{1}{2}$ .

Fig. 13. Case 17. Ninety-three days after operation.  $\times 3$ .

Fig. 14. Case 1. *Rana virescens* with regenerated reversed tail of another individual. Regenerated thirty-eight days.  $\times 3\frac{1}{2}$ .

Fig. 15. Case 1. Regenerated eighty-nine days.  $\times 3$ .

Fig. 16. Case 4. Same combination as Fig. 14. Tail regenerated forty-two days. Forked spinal cord.  $\times 3\frac{1}{2}$ .

Fig. 17. Case 2. Same combination as in Fig. 14. Regenerated thirty-seven days.  $\times 3\frac{1}{2}$ .

Fig. 18. Case 5. Combination as in Fig. 14 except that both larvae are *Rana palustris*. Tail regenerated sixteen days.  $\times 3\frac{1}{2}$ .

Fig. 19. Case 10. *Rana palustris* with reversed tail of another larva grafted to its back. The transplanted tail has regenerated from both ends (twenty-two days).  $\times 3\frac{1}{2}$ .

Fig. 20. Same combination as in Fig. 19 except that a small portion of yolk was transplanted with the tail. Regenerated sixteen days.  $\times 3\frac{1}{2}$ .

Fig. 21. Case 12. *Rana palustris* with accessory tail grafted to the back. Twenty-one days after operation.  $\times 3\frac{1}{2}$ .

Fig. 22. Case 11. Same combination as in Fig. 21. Sixty-nine days after operation. Accessory tail to a great extent atrophied.  $\times 2\frac{1}{2}$ .

##### PLATE XI.

(All specimens preserved in formalin.)

Fig. 23. *Rana virescens*, adult female just after spawning.  $\times \frac{1}{2}$ .

Fig. 24. *Rana virescens*, adult male.  $\times \frac{1}{2}$ .

Fig. 25. Same individual as in Fig. 5. Head, *Rana virescens*; trunk and limbs, *Rana palustris*. Preserved one hundred and forty-three days after operation, or seventeen days after metamorphosis.  $\times 2\frac{1}{2}$ .

Fig. 26. *Rana palustris*, young specimen.  $\times \frac{1}{2}$ .

## ENDOCARDITIS DUE TO A MINUTE ORGANISM, PROBABLY THE BACILLUS INFLUENZA.

(PRELIMINARY REPORT.)

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Endocarditis of infectious origin is associated with the presence of many species of pathogenic bacteria; although most commonly the result of the invasion of the pyogenic cocci, other bacteria are capable of producing the characteristic lesions of the disease. Since the discovery of the bacillus influenza by Pfeiffer a number of instances of endocarditis accompanying influenza have been described clinically, but thus far, although this micro-organism has been found in various locations in the body, such as the lungs and the meninges, where it has set up inflammatory processes, it has not been demonstrated in the anatomical lesions of endocarditis. There have come to autopsy in the pathological labora-

tory during the last three years three cases of endocarditis in which bacilli were found in the lesions of the heart-valves agreeing morphologically with the influenza bacillus, and probably identical with this organism. As the cases are of interest on account of their probable etiology they will be reported briefly in this place.

CASE 1.—C. K. Colored. Male, age 20. Autopsy by Dr. Flexner, 3/21/96.

*Anatomical Diagnosis.*—Acute ulcerative and chronic proliferative endocarditis affecting the mitral, aortic and tricuspid valves; mitral stenosis and insufficiency; rupture of chordae tendineae of mitral valve; perforation of aortic segments;











adhesion of leaflet of tricuspid valve to ventricular wall; globular heart thrombus; cardiac hypertrophy and dilatation; compression, congestion and infarction of the lungs; hemorrhagic nephritis; oedema.

Only that part of the protocol relating to the heart will be given. The organ is enlarged, weighing together with the pericardium 1050 grams. The hypertrophy affects both sides. The tricuspid valve is the seat of thickening and the segments have become united. The chordae tendineae are likewise thickened and contracted and the trabeculae and papillary muscles are hypertrophied. The cardiac muscle is the seat of marked fatty degeneration. In the apex of the right ventricle there is a globular thrombus lightly attached to the wall. The left ventricle is especially enlarged, all the parts being hypertrophied. The chordae tendineae are diffusely thickened, and they are also the seat of minute excrescences between which small erosions exist. Similar vegetations cover the margins of the segment of the mitral valve and the endocardium of the auricle. A tendinous cord proceeding from the right papillary muscle to the mitral valve is ruptured and the fresh edges of the torn thread are covered with recent thrombi. The leaflets of the valve are grown together and thickened. A considerable mass of vegetations extends upwards from the aortic segment of the mitral valve to the aortic valve, covering the inner surface of the aortic segments. Several perforations exist in the right segment.

*Bacteriological Examination.*—The cover-slip preparations made from the vegetations of the cardiac valves are crowded with micro-organisms. These consist of small bacilli, usually straight, but sometimes curved. They stain both solidly and at the poles. These rods are chiefly free, but many are also contained within the protoplasm of leucocytes. No other form of micro-organism was found in the cover-slips. Cultures made upon agar from the unopened heart gave no growth. After opening the heart second cultures were made, and these grew a variety of micro-organisms which were regarded as accidental. The minute bacillus described was not present in the rank growth.

CASE 2.—W. W. Colored. Male, age 37. Autopsy by Dr. Flexner, 10/22/96.

*Anatomical Diagnosis.*—Chronic mitral endocarditis and stenosis; sclerosis of coronary arteries; vegetative and ulcerative endocarditis of mitral and aortic valves; chronic passive congestion.

The heart is hypertrophied, its weight being 470 grams. The leaflets of the mitral orifice are thickened and grown together, and the orifice is narrowed. The chordae tendineae are also thickened and shortened. The edges of the valve are incompletely covered with vegetations which can be traced from this situation to the aortic valve, the middle segment

of which shows two perforations. The tricuspid valve is free.

*Bacteriological Examination.*—Films from the mitral valve show great numbers of short slender bacilli, sometimes slightly curved. These show distinct polar staining. By Gram's stain they are completely decolorized. Cultures upon agar-agar were negative. Sections of the mitral valve stained for bacteria showed large numbers of organisms similar to those described in the cover-glass preparations.

CASE 3.—G. M. White. Age 17 years. Autopsy by Dr. Flexner, 2/22/98.

*Anatomical Diagnosis.*—Stenosis of the pulmonary artery; chronic and acute endocarditis of pulmonary valves; vegetative pulmonary arteritis; heart hypertrophy; hemorrhagic infarction of lungs; chronic passive congestion.

The heart is enlarged, weighing 400 grams. The mitral and aortic valves are normal. The tricuspid valve, except for a hard calcified nodule is also normal. The pulmonary orifice is stenosed; the leaflets of the valve are grown together, the segments being diffusely thickened. The free edges of the valves are covered with vegetations which extend into the pulmonary artery and its primary branches.

*Bacteriological Examination.*—Film preparations made from the vegetations upon the pulmonary valve and artery show many polymorphonuclear leucocytes with fragmented nuclei. The protoplasm of these cells is filled with minute bacilli, and similar organisms are found outside, probably liberated by disintegration of the cells. They are straight or curved and stain either uniformly, or more deeply at the poles. Cultures on agar-agar from the unopened heart were negative. After opening the heart and some handling a second series of cultures was made, which however became contaminated. The minute organism seen in the films did not appear in these contaminated cultures. Sections of the pulmonary valve and artery show chronic fibroid thickening with recent thrombi. In these thrombi large numbers of minute bacilli were found. Sections of the lung show, besides the chronic congestion, similar bacilli which occupy the alveolar spaces.

The above cases present an infection of the endocardium with minute bacilli possessing characteristics in common. The morphology of the bacilli, their staining reactions, and their difficulty of culture agree with the properties of the bacillus influenza. Unfortunately, the organisms were not obtained in cultures, so that one link in the chain of proof that the organism is the bacillus of influenza cannot be supplied. Perhaps the conditions under which the cultures were attempted may be responsible for the failure to obtain growths even when suitable media were employed. On the other hand the vast numbers of organisms described which were found upon the diseased heart-valves leave no question of their causal connection with the pathological process.

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## OBITUARY.—EDWARD P. McKEOUGH.

At a meeting of the Class of Nineteen Hundred and One, of the Johns Hopkins Medical School, held October the twenty-first, Eighteen Hundred and Ninety-Nine, the following resolutions were adopted:

WHEREAS, It has pleased God, in his infinite wisdom, to remove from our midst our beloved friend and classmate Edward Patrick McKeough; therefore be it

*Resolved*, That we, the members of the Class of Nineteen Hundred and One, of the Johns Hopkins Medical School, do deeply regret the loss of one who has been a true and loyal

man, and whose life and character will ever be an example for his friends to follow; and

*Resolved*, That we express to his family our most heartfelt sympathy in their great bereavement; and

*Be it further Resolved*, That a copy of these resolutions be sent to his family and published in the BULLETIN of the Johns Hopkins Hospital.

H. P. PARKER,	} Committee.
R. T. COMER,	
MARION WALKER,	
J. R. BOSLEY,	

## PROCEEDINGS OF SOCIETIES.

### THE JOHNS HOPKINS HOSPITAL MEDICAL SOCIETY.

#### Report of Gynaecological Cases. Dr. KELLY.

CASE 1. *Extensive Destruction of the Sphincter*.—This patient was an old syphilitic with extensive ulceration of the bowel which had been present for a number of years and for which a number of operations had been performed. The diseased area could be distinctly felt through the vagina as a rigid fibrous cord extending well up back of the cervix and in some of the operations (she had had 19) the sphincter had been destroyed anteriorly, leaving a boat-shaped scar.

I operated on the 23rd of March of this year and she remained in the hospital until the 25th of April. I performed the following operation, desiring to get rid of this restricted area, and restore the function of the bowel so that she could have easy passages and be able to control them: I divided the septum freely with a pair of scissors, cut across the sphincter and turned it over as a flap, making a U-shaped incision with its convexity forward. Then I followed up the bowel, catching it with forceps and pulling it down and dissecting it out on all sides with scissors. I tied a great many small vessels, dissected out the levator ani, opened the peritoneum and found that at a point opposite the middle of the cervix the lumen of the bowel became normal. I cut the bowel at this point, brought it down and attached the posterior end just behind the sphincter. Then, by a somewhat complicated plan of suturing, I attached the bowel anteriorly and at the sides to restore the sphincter. The result was all I could have desired. She made a perfect recovery and now has entire control over the function of the bowel.

CASE 2. *Carcinoma Uteri*.—This patient had probably the most advanced carcinoma of the uterus I have operated upon satisfactorily since I have been at work in this hospital. The lower part of the uterus was destroyed and the disease extended anteriorly so far that there was some doubt about the involvement of the floor of the bladder. She stood a prolonged operation of about two hours very well. Had she not been in such good condition at the time I could not have

attempted it. I first introduced bougies into each ureter so as to have them under observation at all times. This is a *sine qua non* to success in all such operations, for we can at any moment see just exactly where the ureters are. I then made an incision in the vault of the vagina and began by freeing the bladder from the vagina and separating it from the uterus; then catching the uterus at the fundus I pulled it down through the opening in the vaginal wall. Next I tied off the vessels of the broad ligament in the upper part, split the uterus in two, which made it more movable, thus enabling me to turn the two portions down into the vagina and so get at them more readily. I removed first the easiest side, taking care to get as far as possible from the uterus and avoid the ureter which was constantly in view; I then attacked the more difficult side. When I got down to the base of the broad ligament, I was able to show very well the risks one experiences when the ureter is not catheterized. It could have been doubled on itself and if the bougie had not been in place I might have felt perfectly safe in thinking it at some other point than the place it really occupied. I amputated the diseased portion of the ureter, incised the bladder and stitched the ureter to it. The patient has done very well ever since and there is every reason to believe that she will make a good recovery.

I think we are going to occupy a very different attitude towards these carcinoma operations in the future. We are coming back to the vaginal operation, but this will be performed in a different way from former methods. Fifteen years ago the uterus was always removed by vaginal hysterectomy. It was skinned out, this being done to avoid the danger of tying the ureters, but, of course, bits of carcinomatous tissue were always left in. Some of us, to avoid this, went over to the abdominal route. Drawing our inferences from the operations performed on the surgical side of the house in breast cancer, we thought we should get better results by removing the glands with the uterus. We did some satisfactory operations, taking out all the pelvic glands we could find. Very painstaking and thorough examinations made by Dr. Cullen in our laboratory showed, however, that our conclusions were not warranted and that the disease

extended directly up from the cervix, the glands being involved only in the late stages, or in cases that were not operable. I have, therefore, come back to the vaginal operation, performing it, however, in a new way. I make an incision, begin above and work down, splitting the uterus and with bougies in the ureters so as to know at all times where they are. All that is necessary is a patient that has not been so weakened by hemorrhages or disease that she will not be able to stand a prolonged operation. I am glad for many reasons to come back to this operation again.

**CASE 3. Excessive Growth of Fat.**—A patient thirty years of age came in the other day because of an enormous development of fat in the body and I removed the large mass before you from the abdominal wall. She had a pendulous abdomen and was glad to get rid of some of the superfluous fat so as to enable her to walk around with comfort. Her weight was 285 pounds and this mass, which is larger than the ordinary woman's whole belly, was removed, the edges of the wound being brought together without tension. It weighs 7,450 grams and forms an interesting contrast to a small lipoma of the thigh about the size of my fist that I removed a few days before.

**Dr. WELCH:** It is of interest that the prognosis is relatively favorable after hysterectomy for uterine cancer. This is, of course, due to the late period at which metastases are prone to appear. There are two forms of cancer of the uterus, the flat-celled of the cervix and the adeno-carcinoma of the body. The latter originates in the mucous membrane, extends down slowly into the wall of the uterus and it is a significant fact that the metastases occur generally quite late. It is as if the wall of the uterus was a sort of case and prevented the ready entrance of the cells into the lymphatic or blood current, as occurs with cancers developing in the interior of ovarian cells. The flat-celled epithelioma does not form secondary deposits in the lymphatic glands so readily as most cancers do and this is true in general of flat-celled epithelioma.

#### NOTE ON NEW BOOKS.

*The Mechanics of Surgery*: comprising detailed descriptions, illustrations and lists of the instruments, appliances and furniture necessary in modern surgical art. By CHARLES TRUAX. (Chicago, 1899.)

The object of this book is to present to surgeons careful detailed descriptions of instruments used in surgical operations, and also of instruments for general medical research, such as microscopes, thermometers, stethoscopes, sphygmographs, aesthesiometers, dynamometers, etc. The work seems carefully and judiciously done, and the result is a book of great utility to the surgeon and physician. The descriptions of instruments are very complete, and the accompanying illustrations are helpful to those who wish to identify instruments and determine in their own minds what they may use for particular operations. The information is exact and covers the more recent surgical appliances like Laplace's anastomosis forceps and Murphy's button. It is difficult to call to mind any surgical instrument of permanent value which may not be found described or pictured in this handsome volume of 1000

pages. The author deserves great credit for the thorough manner in which he has worked out his ideal of the utility of such a book. He has avoided trenching upon technical ground, and yet has produced a very helpful handbook.

#### BOOKS RECEIVED.

*Seventeenth Annual Report of the Provincial Board of Health of Ontario.* Being for the year 1898. Printed by order of the Legislative Assembly. 1899. 8vo. XXXVIII + 322 pages. Warwick Bros. & Rutter, Toronto.

*Report of the Commissioners of the District of Columbia* for the year ended June 30, 1898. Vol. III. [Health Department.] 8vo. 261 pages. 5 maps. 1898. Government Printing Office, Washington.

*United States Treasury Department, Marine Hospital Service. Centennial Year.* Annual report of Supervising Surgeon General of the Marine-Hospital Service of the United States for the fiscal year 1898. 8vo. 855 pages. 1899. Government Printing Office, Washington.

*A History of the Chronic Degenerative Diseases of the Central Nervous System.* By Thomas Kirkpatrick Monro, M. A., M. D., 1895. 8vo. 82 pages. Alex. MacDougall, Glasgow.

*Atlas of Diseases of the Skin, including an Epitome of Pathology and Treatment.* By Prof. Dr. Franz Mraček, of Vienna. Authorized translation from the German. Edited by Henry W. Stelwagon, M. D., Ph. D. With 63 colored plates and 39 full-page, half-tone illustrations. 1899. 12mo. 199 pages. (Saunders' Medical Hand-Atlases). W. B. Saunders, Philadelphia.

*The Mechanics of Surgery*: comprising detailed descriptions, illustrations and list of the instruments, appliances and furniture necessary in modern surgical art. By Charles Truax. 1899. 8vo. 1024 pages. Chicago.

*Report of the Board of Managers of the Pennsylvania Hospital to the Contributors*, at their annual meeting held fifth month second, 1898. Comprising the report of the department for the sick and wounded and of the departments for the insane, etc. 8vo. 108 pages. 1897-98. Avil Printing Co., Philadelphia.

*Thirty-fifth Annual Report of the Trustees of the Boston City Hospital, with report of the Superintendent, February 1, 1898, to January 31, 1899, inclusive.* 1899. 8vo. 206 pages. Municipal Printing Office, Boston.

*Illustrirte Rundschau der Medicinisch-Chirurgischen Technik.* Herausgegeben von Gustav Beck. 1898. Jahraang I. 8vo. 416 pages. 1898. K. J. Wyss, Bern.

*Mount Sinai Hospital Reports.* Volume one for 1898. Edited for the Medical Board by Paul F. Mundé, M. D., LL. D. 8vo. 343 pages. 1899.

*Thoracic Resection for Tumors Growing from the Bony Wall of the Chest.* By F. W. Parham, M. D. 1899. 8vo. 147 pages. New Orleans.

*Cavendish Lecture: On the Etiology and Diagnosis of Cerebro-Spinal Fever.* By William Osler, M. D. [Reprinted from the "West London Medical Journal."] 1899. 8vo. 46 pages. John Bale, Sons & Danielsson, Ltd., London.

*An Introduction to Dermatology.* By Norman Walker, M. D. With a frontispiece. 29 plates and 34 illustrations in the text. 1899. 8vo. 247 pages. John Wright & Co., Bristol.

*Our Baby: For Mothers and Nurses.* By Mrs. Langton Hewer. Sixth edition. Revised, 1899. 12mo. 154 pages. John Wright & Co., Bristol.

*Metropolitan Asylums' Board.* Annual Report, 1898, Vol. I. 1899. 8vo. 114 pages. McCorquodale & Co., Limited, London.

*Metropolitan Asylums' Board.* Annual Report, 1898, Vol. II. Thirtieth Report of the Statistical Committee with Appendices. 1899. 8vo. 192 pages. McCorquodale & Co., Limited, London.



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# BULLETIN

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### SCIENTIFIC LABORATORIES.\*

BY PROFESSOR WILLIAM KEITH BROOKS *of Johns Hopkins University.*

I regret that I am one of those who have learned to call the century that is now drawing to a close *our* century. I find my chief recreation and inspiration in reflecting upon that great extension of natural knowledge which we owe to the master minds of the nineteenth century. I would not have you infer that I do not hope for a share in some of the great things of the future, although I do find it hard to remember that the difficulties which our great men have overcome, their struggles, and failures, and successes, are even now becoming ancient history; that the thoughts and the hopes of the audience which is now best worth addressing are in the future. The great men of the nineteenth century have won results that can never be forgotten; but the sympathy of those who remember the small beginnings of these great results, the patience, the courage, and the untiring industry by which each little step was won, will soon be a thing of the past.

Some of you, who hear me to-day, may hope to see things that our poets have only dreamed—many things that no poet ever has dreamed, no prophet foreseen, things that it hath not entered into the heart of man to conceive; but, as you enter upon your inheritance of great opportunities, will it not be well to remember that they are an inheritance? Not that it will matter to the men who are gone, whether they are remembered or forgotten. It has been my good fortune to know

some of the great scientific discoverers of our day, while I believe that I know others still more intimately through their works and the story of their lives, and through the records of their influence upon others; and I believe I may honestly assert, in their name, that hope of remembrance by posterity had little part in their inspiration. It is not in their interest, but in yours, that I ask you to be mindful of your debt to them. If the men of the twentieth century find themselves better equipped for the discovery of truth than any who have gone before, if they have more and better means for the extension of natural knowledge and the relief of man's estate, they owe most of their advantages to the pioneers of the nineteenth century. Now, a pioneer is a man who has faced difficulties; one who has made his own opportunities. Often is he one who has brought out of this struggle those high qualities of fearlessness, and independence, and tenacity of purpose, and single-minded honesty, which, important everywhere, are absolutely essential for progress in science. To be what is commonly called self-made, either in generations or in men, is not a distinction but an advantage. It is for this reason that I ask you to keep warm your sympathy for the men who have done great works in science in the past, with scanty facilities, and in the face of difficulties.

In order to duly estimate the full importance and the grandeur of the century which is now nearing its close, especially as regards man's increased power over nature, and the application of that power to the needs of human life, we must, says Wallace, compare it, not with any preceding century, or

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even with the last thousand years, but with the whole period of human history; yet it is not the progress in science which this century has made, but the means and the opportunities for still greater progress which it has put into the hands of future generations, which has seemed, to thoughtful men, to be its great distinction. One of the most important instruments for scientific discovery which the nineteenth century has put into the hands of the twentieth is the scientific laboratory. This too is one of its latest gifts, for it is only within very recent years that all the books and apparatus and appliances and material that are needed for the advancement of great departments of natural knowledge have been brought together in buildings constructed for the purpose, and placed under the supervision and direction of investigators who are qualified to use all these great advantages and opportunities for the promotion of knowledge and for the instruction and training of students. The last quarter of the nineteenth century is emphatically the birthday of laboratories, although the needs of different departments of knowledge were not all recognized or provided for at the same time. The chemical laboratory has come down to us from the days of alchemy, and we are told that there have been astronomical observatories in Europe for five hundred years, but most of the scientific laboratories which are so characteristic of our day are very modern. The form of application to the U. S. Treasury for alcohol for scientific purposes free of duty says that this law "is not held to include 'physical,' 'mechanical,' 'electrical,' or 'pathological' laboratories, or any other laboratory which has been developed since Feb. 21, 1873, when the law was passed."

It was my good fortune to have a share in one of the first attempts to organize laboratory instruction in natural science in Cleveland, and I hope you will pardon me if, on this occasion, my mind runs back to this old undertaking. In 1875 three young men who had begun to train themselves as naturalists came together for their summer vacation at their homes in Cleveland. They were Theodore B. Comstock, afterwards President of the University of Arizona; Albert H. Tuttle, now Professor of Biology in the University of Virginia, and myself. We were filled with enthusiasm for our work, and, like all earnest students from Chaucer's day to this, as glad to teach as to learn, and we determined to organize a summer class for laboratory instruction in zoology and botany. Money for our expenses was liberally supplied by R. K. Winslow, Leonard Case, and other citizens; the authorities granted us the use of the old high-school building on Euclid avenue, near Erie street, and we were soon able to issue notices of our undertaking, and invitations to all who wished to join the class, asking them to do so without the payment of any fee. Some twenty-five were soon enrolled, most of them teachers, some from a distance, and work was begun with a class which shared all the earnestness and enthusiasm of their instructors. We had daily lectures or demonstrations, followed by four or five hours of work in the laboratory, while two afternoons in each week were given to excursions to Rocky River, Cuyahoga Falls, and other places favorable for the out-of-door study of nature. As a small steamboat had been placed at our service, we made two excursions upon the lake, and thus gave to the class an opportunity to learn the use of the naturalist's dredge for collecting the

animals of the bottom. Our work was, in part, the study of the animals and plants which we obtained on these expeditions, and we also made use of a supply of marine animals which had been gathered for the purpose at the seashore.

I do not know that I can trace any continuity between this summer class of 1875 and the beautiful and thoroughly equipped Biological Laboratory in which we have met to-day; but the anecdote may serve to remind some of those who will, in future years, make use of the resources and facilities which are here so liberally supplied, that they owe the modern scientific laboratory to men who were, for the most part, obliged to do their work without aid from others. In making this great gift to the men of the twentieth century, they of the nineteenth bid you "Godspeed" in the use of this great agent for the service of your race, for they are sure that, in your hands, it will make known to mankind wonders of nature which eye hath not yet seen nor ear heard. They charge you, however, not to forget that opportunities do not make success; for the greatest success, in science as in all other works, has been won by men who made their opportunities. A good horse helps the traveler on his way, but he who rides because he is not able to walk is not likely to make a long or a successful journey. Some tell us that there is a law of evolution, a necessary principle of universal progress, that carries things along; that the great advances in scientific knowledge which have been made in our day will continue to run on by virtue of this principle—that if the heirs of all the ages will but wait until they come to man's estate their inheritance will drop into their laps. I have no patience with this sort of nonsense. Natural laws are not agents who do things, but generalizations from an experience which seems to teach, among other things, that progress is neither necessary nor universal. I am sorry to say that my own experience of life tells me that it is, unfortunately, a little easier to stand still or to slip backward than to go up hill. The only necessary law of progress that I can discover is that it is necessary to fight pretty hard for everything worth the getting, and that it is no light or easy task to keep what has been won. There have been dark ages in human history, and periods of great intellectual activity have been followed by periods of stagnation and decay. Natural knowledge is not like the corn that grows while we sleep; for, if the price of civil liberty is eternal vigilance, the price of intellectual liberty is vigilance even more alert and untiring.

The scientific men of the nineteenth century do not fear for their successors. They are confident that you will not be found wanting in the high qualities that win success, although the road ahead of us looks very much like that over which we have come, with a few smooth, easy places, and many that are rough and hard. They have no fear that you will be impoverished by prosperity, but if you take it for granted that you are destined to great things because you have great opportunities and great advantages, your end will be disappointment and decay; for you are destined to do nothing except what you determine to do, and fight for, and succeed in doing. To you they intrust the full fruition of the scientific laboratory. They consign it to you with confidence, and without fear; but they do not believe any one will charge them with boasting, if they assert that it has not been entirely fruitless in their hands; for

a history of scientific laboratories during the last thirty years would be a history of all that is most notable and distinctive of this period, as compared with those that have gone before. It is a history that no one man can write, and a bare enumeration of the discoveries that have been made by the methods of the laboratory would far exceed the limits of my time and of your patience.

Wallace, in his recent book on the Wonderful Century, gives a list of the inventions and practical applications of science which are perfectly new departures, and which have also so rapidly developed as to have profoundly affected many of our habits, and even our thoughts and our language; so that they are comparable, in their effects upon mankind, to the telescope and the printing-press and the mariner's compass and geometry and writing. He finds that while there have been only seven of these scientific inventions of the first rank, in all human history up to the end of the eighteenth century, there have been thirteen in the nineteenth, and of these thirteen, eleven are the products of the laboratory. The seven great inventions which Wallace enumerates for all preceding ages, are alphabetical writing, Arabic numerals, printing, the thermometer and barometer, the telescope, the steam-engine and the mariner's compass; while his list for the nineteenth includes railways, steamships, electric telegraphs, the telephone, lucifer matches, gas illumination, electric lighting, photography, the phonograph, Roentgen rays, spectrum analysis, anaesthetics, and antiseptic surgery. Whether we agree with Wallace that these thirteen are the greatest inventions of our century or not, all will agree that they are very great inventions, with boundless possibilities for the service of man, and that most of them are the products of the methods of the laboratory.

But I would not have you suppose that they are the greatest or the best products of work in laboratories; for the improvement in our material resources is not the end which thoughtful men have found most worthy of their devotion. If natural knowledge were only a sort of fairy godmother, ready to furnish her pets with shoes of swiftness, swords of sharpness, and omnipotent Aladdin's lamps, so that they might have telegraphs to Saturn, and see the other side of the moon, and thank God they are better than their benighted ancestors, Huxley tells us that he, for one, should not greatly care to toil in the service of natural knowledge. "I think," says he, "I should just as soon be quietly chipping my own flint ax, after the manner of my forefathers a few thousand years back, as be troubled with the endless malady of thought which now affects us all, for such a reward. But I venture," he asserts, "to say that such views are contrary alike to reason and to fact." Laboratories have done better things for mankind than the invention of material comforts, and I believe that one of these better things—not by any means one of the best, but still a thing well worth doing—has been to teach some, who would not otherwise have learned the lesson, the dignity of manual labor and the value of skilled labor. In plain English, a laboratory is the place for labor, a workshop. Every one who is well trained in its methods is a handicraftsman, a skilled workman.

If you were asked what workmen best show how much may be done by training to develop the latent delicacy and exact-

ness of human fingers and human eyes, you would, no doubt, think of the engraver and the watchmaker. A watch, so well made that it tells the passing seconds through a long human life, and is as accurate after all these years as when it was new, is a wonderful example of skilled workmanship. When we reflect that technical training can give to human hands the delicacy and firmness to cut in hard steel the engraving for a treasury-note, with every line so true that a lens must be used to show the excellence of the work, it is not strange that the engraver should be selected to show what manual training can accomplish; but I hope you will not charge me with arrogance if I assert that the best examples of technical skill are to be found in scientific laboratories. In an address to workmen, Huxley thus asserts his right to speak to his audience with authority: "The fact," he says, "is, I am, and have been any time these thirty years, a man who works with his hands—a handicraftsman. I do not," he declares, "say this in the broadly metaphorical sense in which fine gentlemen, with all the delicacy of Agag about them, trip to the hustings about election time, and protest that they too are workmen. I really mean my words to be taken in the direct, literal and straightforward sense. In fact, if the most nimble-fingered watchmaker will come to my workshop, he may set me to put a watch together, and I will set him to dissect—say—a black beetle's nerves. I do not wish to vaunt," says Huxley, "but I am inclined to think that I shall manage my job to his satisfaction sooner than he will do his piece of work to mine. In truth, anatomy, which is my handicraft, is one of the most difficult kinds of mechanical labor, involving as it does not only lightness and dexterity of hand but sharp eyes and endless patience."

But to tear down or take to pieces is not to build up, and some who admit that the study of anatomy calls for long training may nevertheless assert that the work of the anatomist is not constructive but destructive. It is to show the error of this assertion that I ask you to listen to a short outline of a bit of constructive work of great delicacy which is carried on daily in biological laboratories. The zoologist uses many fine tools, among them the sharp-pointed dart which he dissects out from the sting of the bee, but he often needs to study complicated organisms which are too minute or too delicate for such rough implements. When he wishes to study the structure of some organism too small or too delicate for ordinary dissection, and too opaque for examination with a microscope, he cuts it up into sections or slices which, when properly prepared, will be transparent and favorable for examination with a microscope. The apparatus which he uses for this purpose is so exact that a skillful hand may, by means of it, cut sections so thin that two days, of eight hours each, are needed for cutting into sections an object an inch long, one cut and the return of the knife for the next cut being made every two seconds. If to this be added the time given to handling the delicate sections, to placing them in order, and to their preparation for examination with a microscope—work so delicate that fingers and eyes are taxed to their utmost limit—more than two weeks of uninterrupted labor must be bestowed upon an object an inch long, before it is ready to be studied, and before the real task begins.



The mere examination with a microscope of twenty or thirty thousand sections is the work of weeks, but this alone will not accomplish the purpose of the student. His aim is to gain a knowledge of the organism as a whole, as it would appear if it were enlarged as much as the section under the microscope; and he must therefore combine all the thirty thousand sections in a single view. Now, the human mind cannot grasp thirty thousand objects at one time, or directly compare them with each other, and if the student is to picture to himself the organism as it would be if all the sections were replaced in series, he must acquire the art of reconstructing, in wax or clay, or on paper, or in his mind, solid objects from transverse sections. If the master mechanic who is able to build a ship from drawings of sections and elevations is a skilled workman, no one can refuse the same name to a naturalist who thus reconstructs an organism from sections. Every one knows the practical value of the ship-builder's work, but the naturalist is often asked what reason there is for all his hard labor. I have observed, however, that they who ask why students in laboratories work so hard are commonly the very persons who assert that the higher education of our young men breeds habits of idleness, and unfits them for the serious work of life. You remember that Montaigne tells us consistency is the last thing we can expect from human beings, since he asserts that men "change as that beast that takes the color of the place wherein it is laid"; but you will, no doubt, agree that one who, while asking why students in laboratories work so hard, asserts that work in laboratories encourages idleness, does not merit the serious consideration of those who try to be consistent.

It has always been the lot of the majority of mankind to earn their bread by doing common-place, tiresome things, in common-place, tiresome ways, and if education made young men reluctant to do their duty in that state of life to which it shall please God to call them, it would be a mistake. But I do not know any way to find out what is that state of life to which a young man is called, except to give him the opportunity to train and develop all his faculties to the limit of his capacity, in order that he may discover what is that state of life in which he can do the best for himself and the most for his fellowmen. Some look upon the college with distrust because they fear that it may foster a tendency to esteem men because of some mere accident of birth, or position, or opportunity, rather than for their inherent worth. I do not feel able to say whether social rank is or is not becoming more marked among us. The problem is too difficult for me, and there seems to be much to be said on both sides; but I do not believe that the most radical of socialists sees any sign of the establishment of an aristocracy of learning. In fact, many an old-fashioned pedagogue sighs for the return of the day when the village should all declare how much he knew.

If it is true that human sympathies are growing narrow instead of broad, I do not believe that this can be laid to the door of education; for the modern university, with its scientific laboratories, seems to me to be distinctively democratic in its influence. However the case may have been with what, forty years ago, was called the education of a gentleman, it seems to me to be one of the services of the scientific laboratory, that it has taught to that part of mankind which has leisure and

opportunities, that manual skill is a thing to be held in honor, both as a means for reaching mechanical results, and, still more, as a way to train the mind. One need not be very old to remember the day when it was held a baseness to write fair, or to exhibit mechanical efficiency of any sort. Even at the present day, we find, now and then, in a scientific laboratory, a young man who asserts that he cannot draw, although he quickly discovers the deficiency in his early training and seeks to correct it.

Fifty years ago many men who called themselves educated were mere untrained, undeveloped children in manual skill, and some of them were proud of their incompetency; for nothing would have more surprised them than an assertion that their inability to help themselves with their hands was a badge of ignorance, although they would, no doubt, have treated the assertion with the contempt which they thought it merited. Artists and physicians were trained workmen, but the artist was looked down upon as a Bohemian, outside the pale of good society. He was expected to receive the notice of the elect with proper humility, and, keeping himself in his place, to learn that admiration for his work gave no claim to personal respect. While the high character and sterling worth of the medical man have always won respect, his skill in the use of his hands was long held by those who were superior to any such weakness, to place him beneath the lawyer and the clergyman in the social scale. "If such a woman," says Major Pendennis, "chooses to run away with her uncle's doctor, and marry below her rank,—why, I don't think it a laughing matter, hang me if I do." Major Pendennis was an old fogey, and the world moves; for Oliver Wendell Holmes, M. D., tells us, in 1881, that "An English bishop proclaimed the fact before an assembly of physicians the other day that he was not 'ashamed to say that he had a son who was a doctor.' Very kind that was of the bishop," says Dr. Holmes, "and very proud his medical audience must have felt. Perhaps he was not ashamed of the Gospel of Luke, the beloved physician, or even of the teachings which fell from the lips of One who was a carpenter, and the son of a carpenter."

I doubt whether any one now thinks that an artist or a physician who has trained his hands and his eyes is, on this account, any less worthy of esteem and respect than one who has undertaken to educate his mind by neglecting his body. I also believe that the change is due in no small degree to the influence of laboratories; for out of the laboratory for research in pure science there has grown, on the one hand the technical school, and on the other the manual-training school and the kindergarten; while a view of the very nature of education itself which the professor of the old school would have branded as dangerous, if not positively wicked, has come to be universally accepted. The old view of education, which had come down to us from mediæval times, was that, since the body is essentially base and material, while the mind is something of a different and higher nature, so unfortunate as to be shut up for a time in a vile body, the true way to train the mind is to get at it directly, neglecting the body; although the old-fashioned pedagogue found, as a practical matter, that he could not get even the Latin grammar into the mind of a common school-boy without severely exercising a part of the boy's anatomy which

shows little fitness for improvement by exercise. There are still some, no doubt, who view with alarm as savoring of materialism, the assertion that our bodies are part of our minds, and that bodily training is mental training, although it is hard to imagine what would have been the astonishment of good Bishop Berkeley, had he been told that any one would be disquieted, well nigh two hundred years after the publication of the essay on Human Knowledge, by the conviction that the bodies which we see and feel and use, and the brains which we discover by reflection, are part of our minds. At any rate, the educational reform has come about, and the truth that bodily training is mental training has penetrated our whole educational system. A man who is unable to use his hands in the ordinary affairs of life is now considered to be, in so far, not learned but incapable, and no more worthy of honor than those ants which are so helpless that they starve to death in sight of food when they are deprived of the service of their slaves.

You will tell me, however, that while it is undoubtedly a good thing to teach a few foolish people what a little common sense should have taught them long ago, it is not a great thing. I quite agree with you. The educational reform which has been brought about by scientific laboratories is only one of their small fruits, although we could better spare some famous inventions; for, small as it is, it is an intellectual fruit, and not a mere addition to our material comforts, and I need not tell you that all the greatest services which science has rendered to mankind are intellectual services. While it is by her works that science is justified, her temple is not the patent-office but the laboratory. While first undertaken for some purpose of the sort which is commonly called practical, each advance in natural knowledge has led inevitably to profound changes in our thoughts about nature, and in our views of our own places in nature, and of the range and limits of our mind. "What," asks Huxley, "could seem wiser, from a mere material point of view, more innocent, from a theological one, to an ancient people, than that they should learn the exact succession of the seasons, as warnings for their husbandmen; or the position of the stars, as guides to their rude navigators? But what has grown out of this search for knowledge of so merely useful a character? You all know the reply; astronomy—which, of all sciences, has filled men's minds with general ideas of a character most foreign to their daily experience, and has, more than any other, rendered it impossible for them to accept the beliefs of their fathers."

What is true of astronomy is true of all the other departments of science. Their greatest and most practical results, those which have most influenced the human mind, those that mankind can least afford to spare, are intellectual results. For while each advance has seemed, at first, to lead to intellectual disaster, more mature thought and better judgment have soon led mankind to value it at its true worth, and to prize it as a permanent addition to truth; although the difficulty which we find in adjusting ourselves to new conceptions of nature, and in finding their true place in our thoughts, is perennial, for no great extension of natural knowledge ever has won, or is ever likely to win, a place for itself, without an intellectual struggle. The warfare of science has seemed to some, I regret to say even to some scientific men who ought to know better, to be a disas-

ter, and a thing altogether to be deplored, although this does not seem at all clear to me. In fact, I doubt whether the progress of science would have been as uninterrupted and as irresistible as it has been—whether the great scientific generalizations which have done most to correct our misconceptions, and to modify human thoughts and human beliefs would have been so thoroughly analyzed, so completely stripped of all side issues and irrelevant complications, and so well reduced to that simple form which commands assent—if it were not for the natural conservatism of the human mind.

The latter years of our century have witnessed many notable struggles for the establishment of new conceptions of nature. One of the most notable has centered around the discovery, by Wallace and Darwin, that the characteristics of living things have arisen in an unending struggle for existence, in which vague and indefinite adjustments have been slowly converted into exact and definite adaptations, by the extermination of the relatively unfit and the survival of the fittest. The warfare of science seems to me to be only a part of this process of natural selection, for, as Berkeley pointed out long ago: "The work of science is to unravel our prejudices and mistakes, untwisting the closest connections, distinguishing things that are different, instead of confused and perplexed, giving us distinct views; gradually correcting our judgment, and reducing it to a philosophical exactness." If I saw any reason to believe that the coming scientific workers and thinkers are to escape from that intellectual tension which we call obstinate bigotry or enlightened earnestness, according to our point of view, I should be less sure than I am that the march of intellectual progress is to be as irresistible and as uninterrupted in the future as it has been in the past; but I fail to see any such signs. On the contrary, I do see many signs which, if I understand them, show that science is about to demand, in fact is already demanding, changes in the prevailing views of our relation to nature which will bring about an intellectual revolution, compared with which the struggles for the truths of astronomy and geology and zoology are mere skirmishes. As I also believe that this change will be brought about by the general acceptance of the definition of science which I have just quoted from Berkeley, I think we shall find profit in asking what led him to this definition. He lived in a day of great intellectual activity, for Newton's discovery that all the hosts of heaven are a vast mechanism regulated according to simple laws, had made many thoughtful men reflect that all the phenomena of nature may possibly be resolved into the movements of matter according to the laws of mechanics.

Many in Berkeley's day had thought that this view of nature leads to consequences which some looked upon with horror, while they were, no doubt, welcomed by the dissolute courtiers of George I as an excuse for cutting adrift from all the restraints of morality. It was Berkeley's great service to mankind to point out, in a wonderful essay written before his twenty-fifth year, that mechanical conceptions of nature are so far from warranting the inferences of those who, in the seventeenth century, called themselves freethinkers, as to be antagonistic to these inferences, and irreconcilable with them. Berkeley is as thoroughly convinced as any freethinker that all the phenomena in nature are produced by motion; that they



conform to mechanical laws; that the universe and everything in it is a vast machine; but he calls upon the freethinker to examine and find out what he means by a machine, and he points out, as Aristotle had done before him, that a natural law is not a cause, or an agent who does things, but a general rule which teaches us how to act and what to expect. He shows us that we know nothing about matter and motion except what we see and feel and perceive by our senses and discover by reflection; but since perception and reflection are states of mind, it is clear that we cannot perceive or reflect upon anything except what is in our minds, and that the only existence we know anything about is mental existence; for the things I see and feel are my states of consciousness, and the existence of a state of consciousness apart from a thinking mind is a contradiction. "Some truths there are," says Berkeley, "so near and obvious to the mind that a man need only open his eyes to see them. Such I take this important one to be, viz.: That all the choir of heaven and furniture of earth—in a word, all those bodies that compose the mighty frame of the world—have not any substance without a mind; that their being is to be perceived or known."

Some who have never taken the trouble to read Berkeley assert that he teaches that the external world is only a creation of our own minds, or a dream; but this is a gross caricature, for he shows, in a series of beautiful essays and dialogues, by reasoning in which no one has ever found any serious flaw, that while the external world is real beyond the possibility of doubt, its reality is the reality of language, and that nature is a language by which we are entertained and instructed and delighted, and that when we use such phrases as "the language of nature," and "the interpretation of nature," our words are not figurative, but literal. He shows that each event is, in course of nature, a sign of others that may be expected, and that the work of science is to teach us the significance of natural signs, that we may understand things which mean nothing to the ignorant. "As the natural connection of signs with the things signified is regular and constant, it forms a sort of rational discourse. Therefore," he tells us, "the phenomena of nature, which strike on the senses, and are understood by the mind, do form not only a magnificent spectacle, but also a most coherent, entertaining discourse; and to effect this they are conducted, ranged, and adjusted by the greatest wisdom. This language or discourse is studied with different attention, and interpreted with different degrees of skill. But so far as men have studied and remarked its rules, and can interpret right, they are said to be knowing in nature."

Now, language, being an exchange of ideas, implies both a recipient mind and an originating mind; and Berkeley tells us, therefore, "that, setting aside all help of astronomy and natural philosophy, all contemplation of the contrivance, order, and adjustment of things, the bare existence of the sensible world is evidence of a creative mind, because the sensible world is a language. Our way to find out things is not to try to deduce them from mechanical principles, or principles of any sort, with the philosophers, but to listen humbly to the language of nature, as the true men of science always have done. Our part is not active but passive, and so far as we listen attentively and strive to understand, we shall make no mistakes. If, however,

we are not makers of natural knowledge, but listeners, it follows that the work of science is not to add to knowledge, but to "unravel our prejudices and mistakes, untwisting the closest connections, distinguishing things that are different, instead of confused and perplexed, giving us distinct views; gradually correcting our judgment, and reducing it to a philosophical exactness." But the correction of our natural responses, and their reduction to exactness, by the suppression of those that are confused and perplexed, and the preservation of those that are definite and distinct, and ultimately by the extinction of the deluded minds and the survival of those that are sane, is what I understand by natural selection. Just so far as natural selection is a mechanical explanation of the origin of species, just so far is it also a mechanical explanation of natural knowledge.

The most practical and important question which rational human beings can ask is how we may distinguish truth from error, in order that we may be sure about our actions and rightly order our lives; and the greatest service of Charles Darwin to the intellectual life of mankind is that he has led us to ask whether we may not, some time, find a mechanical explanation of that rational judgment which is innate in human minds; whether this may not itself be part of the physical order of nature; whether those judgments which we call errors may not be the ones which lead us into danger and tend to our destruction; whether it may not be because a judgment has proved beneficial in the struggle for existence, that we call it true; whether language itself, even the most rational discourse, may not be a natural phenomenon which lies entirely within the chain of physical causation. All are now familiar with the work of the physiologists in localizing functions of the brain. Every one knows that mental diseases may often be traced to specific pathological causes. The psychologists are occupied in tracing the transformation of the simple, responsive actions of the lower animals and of human infants into the rational actions of man, by a process of gradual correction and adjustment. The philologist, who studies the life and growth of language, tells us that this, too, exhibits mechanical law. From all these sources, and from many others, evidence is accumulating which leads many thoughtful men to believe that the progress of natural knowledge is giving us a physical explanation of mind; that we are making rapid strides towards the discovery of a mechanical equivalent of truth; and that all that choir of heaven and furniture of the earth which we perceive by our senses and discover by reflection, may be no more than one who knows the whole natural history of our bodily frames might have expected.

Now I need not warn those scientific men who will have the task of assuring mankind that these novel conceptions are not pernicious, but wholesome, that their work will be neither light nor easy, although I believe that if Berkeley could revisit us, he would, with a kindly smile, reassure those who find it difficult to reconcile mechanical conceptions of mind with belief in our moral responsibility and in the value of our reason; that he would remind them that mechanical principles are not agents who do things, nor rulers and governors over nature, but only general rules which teach us how to act and what to expect. I imagine he would remind us that our way



to find out things is not to deduce them from mechanical principles, or logical principles, or philosophical principles, or principles of any sort, but to listen to the language of nature. They who are disquieted by the conviction that there is only one kind of knowledge, and but one way to acquire it, should reflect that the scientific method of acquiring knowledge is to listen to the language of nature; and that proof that the scientific method is adequate to all our needs, is proof that this language is adequate to all our needs.

As I understand Berkeley, it is not because nature is a language that he holds it to be intended; but because the language of nature is useful, and instructive, and delightful to hear. Even if we see reason to ask whether this language may not be mechanical and explicable by physical science, I fail to see why we should challenge Berkeley's belief that it is intended, unless we doubt whether the language of nature is useful, and profitable, and delightful. Does any man of science doubt whether the words "language of nature," and "interpretation of nature," are used with clear, intelligible meaning? Is not the question whether nature is a language, which we hear to our delight and profit and instruction, quite a different matter from the question whether the language of nature is or is not mechanical? He who fears that the discovery of mechanical explanations of the language of nature would destroy the

proof that nature is a language, seems no more reasonable than one who, having enjoyed and profited by good books, should assert that these books have lost their use and their power to please and to instruct, through the discovery that they were made by machinery in printing-offices.

The man of science should be the last to doubt the value of this language, even for an instant; for he asserts that it is because exact science does help one walk with sure feet that others grope and stumble, that the promotion of natural knowledge is both the greatest of all pleasures and the first and highest of duties. How can one who knows that natural knowledge does correct our judgment, and help us to avoid the dangers that beset and destroy the ignorant, ask whether nature is a language, profitable to direct? "The attitude of modern science is erect; her aspect serene; her determination inexorable; her onward march unflinching; because she believes herself, in the order of Providence, the true successor of those men of old who brought down the light of heaven to men. Humility may be taken for granted as existing in every sane human being; but it may be that it most truly manifests itself to-day in the readiness with which we bow to new truths, as they come from the scholars, the teachers, to whom the inspiration of the Almighty giveth understanding."

## THE TEACHING OF PSYCHIATRY.\*

By HENRY M. HURD, M. D., *Superintendent The Johns Hopkins Hospital and Professor of Psychiatry, Johns Hopkins University.*

Psychiatry has hardly emerged from the swaddling bands of metaphysics, dogma and tradition. Insanity is no longer considered demoniacal possession, but the terminology of psychiatry is still encumbered with terms which are no less misleading and out of date than were the terms employed a century ago to describe the conditions of ordinary disease. Such a terminology denoting erroneous conceptions of the character of insanity needs to be replaced by a better—or at least by one more consistent with modern knowledge. The old and new are not yet welded together into a harmonious science. Psychiatry once an art only is a new science, if indeed it may even now be considered to have attained to that dignity. If it is a science, it is still in the process of growth and development and has not attained its majority. There are recorded many observations of mental disease, and much clinical work has been done during the past century, but the master mind who is to bring these isolated facts together and weave them into a framework of law has not yet appeared. This work remains to be initiated by one who has the time and leisure to make an exhaustive study of facts covering a period of years and to combine them together in such fashion as may give a conception of mental disease as a whole—such a work as was accomplished by Louis for typhoid fever, pneumonia and tuberculosis. How did he accomplish this? Let me

quote in answer from his friend and disciple, James Jackson. "Returning to France at the age of thirty-two, he (Louis) was about to engage in private practice. He was then led to examine anew the state of the science of medicine, and was dissatisfied with it. He now decided to abandon the thoughts of practice for a time, and to devote himself to observation; that is, to the study of disease as it actually presents itself. With this view he went into the Hospital La Charité in Paris, and followed the practice of M. Chomel, now a physician at the Hotel Dieu and professor of clinical medicine, and highly esteemed as an author. M. Louis passed nearly seven years in studying medicine in this way. The first part of this time he was learning how to make observations. When he thought he had attained this art, he threw away, as I have understood, the notes he had already collected, and began anew to accumulate exact observations of the phenomena presented by the sick and of those derived from an examination after death in the fatal cases. In this course of observations he did not make a selection of cases, but took them as they were presented, indiscriminately. He was not in a hurry to make deductions from his cases, satisfied that he was gathering the materials, from which truth must ultimately be elicited. He was only careful that his observations should be correct, and had not any general principles, or doctrines, for which he sought support or confirmation.

\* A portion of the Presidential Address at the Annual Meeting of the American Medico-Psychological Association in New York, May, 1899.

"To estimate the value of his observations it is necessary to understand the plan on which he collected them. First, then he ascertained when the patient under his examinations began

to be diseased. Not satisfied with vague answers, he went back to the period when the patient enjoyed his usual health; and he also endeavored to learn whether that usual health had been firm, or in any respect infirm. He noted also the age, occupation, residence and manner of living of the patient; likewise any accident which had occurred, and which might have influenced the disease then affecting him. He ascertained also, as much as possible, the diseases which had occurred in the family of his patient. Secondly, he inquired into the present disease, ascertaining not only what symptoms had marked its commencement, but those which had been subsequently developed and the order of their occurrence; and recording those which might not seem to be connected with the principal disease, as well as those which were so connected; also, measuring the degree or violence of each symptom with as much accuracy as the case would admit. Thirdly, he noted the actual phenomena present at his examination, depending for this not only on the statement of the patient, but on his own senses, his eyes, his ears and his hands. Under this and the preceding head he was not satisfied with noting the functions in which the patient complained of disorder, but examined carefully as to all the functions, recording their state as being healthy or otherwise, and even noticing the absence of symptoms which might bear on the diagnosis. Thus all secondary diseases, and those which accidentally co-existed with the principal malady, were brought under his view. Fourthly, he continued to watch his patient from day to day, carefully recording all the changes which occurred to him till his restoration to health or his decease. Fifthly, in the fatal cases he exercised the same scrupulous care in examining the dead, as he had in regard to the living subject. Prepared by a minute acquaintance with anatomy, and familiar with the changes wrought by disease, he looked not only at the parts where the principal disorder was manifested, but at all the organs. His notes did not state opinions, but facts. He recorded in regard to each part, which was not quite healthy in its appearance, the changes in color, consistence, firmness, thickness, etc.; not contenting himself with saying that a part was inflamed, or was cancerous, or with the use of any general but indefinite terms."

In this matter Louis was able to differentiate diseases like typhus and typhoid—which had formerly been confounded—and tuberculosis and pneumonia, and to settle certain general principles which will endure as long as medicine is known as a science. Such a work needs to be done with the various forms of insanity, so that we may know their physical laws and underlying conditions.

The period of vague description and unsatisfactory, because stereotyped, case-books is drawing to a close, and precise definition and numerical methods should take their place. One would think that with the present perfect organization of hospitals for the insane it would even now be possible to ascertain certain facts with great certainty. Take, for example, the oft-repeated statement regarding parietic dementia, that it is increasing, that women are increasingly victims of the disorder, and that the ambitious form is surely disappearing and is replaced by the demented form. Who knows with certainty as to the correctness of these assertions and who possesses the

data for a satisfactory reply to the query? If, however, any method of inquiry, rivaling in accuracy and completeness Louis' numerical method, existed in our hospitals for the insane, how readily such questions could be answered. Many years ago, Sir James Crichton Browne published a most suggestive paper entitled a "Plea for the more Minute Study of Mania," in which he spoke of the desirability of investigating the areas of the cerebral cortex involved in mania in the light of the muscular movements characterizing the maniacal frenzy. The method suggested was most helpful by foreshadowing new methods of investigation and threw much light upon the relations of insane manifestations to morbid brain conditions. An equally interesting study might be made of other insane states, but as yet no one has attempted it. They all deserve painstaking and detailed study. The objection, however, is made to such clinical studies of mental disease that they do not explain mental phenomena and that it is impossible to connect mental manifestations with physical conditions. Mental phenomena, it is said, cannot be weighed and measured; they are evanescent and fleeting and cannot be reduced to grams or grains or measured by instruments of precision. They can be described as emotional states, modes of thought, sense impressions and intellectual judgments. You cannot recognize an emotion by its color or a thought by its outward appearance. Auscultation does not reveal mental processes, nor does the microscope or the aniline dye give any clue to their presence or absence. It might be said with equal correctness that no process yet exists which will determine the difference between a dead or living cell or the complex set of bodily processes which we know as vitality. We can not explain these phenomena but we can deal with them as we would with any other known facts; they are clinical findings and we should seek to know the laws of their normal and morbid manifestations, even if we do not know wherein their vitality resides or the process of its dissolution in death. Until vital processes, which are vastly more appreciable than mental processes, are known and satisfactorily demonstrated it is unjust to charge the alienist with a lack of scientific precision because he does not explain the physical basis of mental action and the conditions of its exercise. The alienist can observe facts, analyze symptoms, record normal and abnormal mental manifestations and seek for the law of their being. This line of careful study is open to all earnest clinicians.

Morbid mental manifestations can also be recorded as mental phenomena in terms intelligent to all students of psychiatry. Their underlying physical basis can sometimes be determined by known methods of investigation. Chemical, bacteriological and clinical methods are all applicable to these investigations. Internal medicine, neurology, surgery and gynecology assist in revealing the morbid process which has given rise to the aberrant mental manifestation. The body metabolism can be studied by physiological chemistry; the physiology of secretion and excretion gives valuable hints; and nerve tire, fatigue effects, reaction time and other phenomena elicited by the methods of psychology throw a flood of light upon neurasthenic and anæmic conditions. But beside and beyond these comes the investigation of phenomena which must be studied by methods peculiar to mental disease, for



which at present we are but inadequately equipped and for a better knowledge of which we must look to the newly organized pathological laboratories which are springing up throughout the United States. To two of these, that of New York, presided over by Dr. Van Gieson, and that at the McLean Hospital, under the able guidance of Dr. Cowles (I mention these specially in no invidious spirit towards others, but simply because I know more of their work—all doubtless deserve equal praise)—to these two laboratories, I repeat, we look for new methods and substantial discoveries. Their utility at first, however, must be confined to those who are familiar with the methods of research work. The superstructure of medical knowledge has been reared slowly and almost imperceptibly by the acquisition of isolated facts which are gathered painstakingly into a confused heap by a multitude of observers ready for the hand of a master-builder, like Virchow with his cellular pathology, or Pasteur with his study of infective processes, or Koch with his bacteria. These research workers must devise new methods far exceeding in delicacy and precision those required by other branches of medicine. Here the workers must have special training and must hew their way through an unbroken forest of facts often without guide or compass. May no one be so unwise as to require a harvest before the ground is cleared and made ready for the seed. All praise to the commissioners in lunacy of this noble State who have had the courage to initiate this great movement and a far-seeing sagacity in the selection of the means to attain success.

I now approach the question of the best method of teaching this most difficult of the branches of medicine, and I think all will agree with von Jaksch's statement before the Congress of Internal Medicine in April last that: "Only one specialty must the student go to the specialist for, and that is mental disease. The importance of this has become so clear in the last few years, the experience required for its proper teaching is of such a special character and yet a knowledge of it is so indispensable, that a special professorship in it is always needed and the study of it should be made obligatory."

In view of the difficulties of the subject and the necessity of a thorough training in all subsidiary branches of medicine, it seems imperative that instruction in psychiatry should be placed in the last year of the medical course. At this time the student will have had a full training in psychology, neurology, physiological chemistry, bacteriology and clinical medicine. When he is ready for this study he should have a review of neurology in its relations to mental disorder. The precision of neurology offers an excellent introduction to psychiatry, and its methods should be transferred to the latter study as far as possible. A word of caution, however, may not be inappropriate. The methods of neurology are inadequate to the interpretation of many of the phenomena of mental disease and an attempt to confine the study wholly to neurological data omits many most important details of mental disease. Hence neurology and its methods, while most valuable, can only serve as an introduction. The futility of depending upon neurology for all the methods of investigation has well been pointed out by Van Gieson in his most suggestive

paper on "The Correlation of Sciences in the Investigation of Nervous and Mental Diseases." The special study of the nervous system as connected with insanity should lead up to a careful study of all insane conditions and special forms of disease. This, in my judgment, should be from a text book or from carefully prepared lectures supplemented by clinical demonstrations of the different forms. These should be supplied by institutions designed for the treatment of acute insanities, and insane patients should be seen and studied until the student has acquired a familiarity with them.\* It is much to be regretted that many of the best institutions for the custody and treatment of the insane are situated so far from centers for medical teaching as to preclude their use as adjuncts of medical schools. It seems of little real utility to introduce students into the wards of a hospital for the insane two or three times a year. The student should see the various phases of insanity frequently, and thus, by watching their development, become thoroughly familiar with them. It is to be hoped that there will grow up in every city a detention hospital—not a detention ward but a well-organized hospital—with facilities for classification, for the reception of all cases of insanity in the dependent or semi-dependent classes, to which could be sent all recent cases of insanity for observation and study. Some of these patients, being cases of ephemeral excitement or of delirium or alcoholic or habit cases might soon regain self-control and return home without being committed to institutions for the insane at all. The majority, however, would probably require to be transferred to such institutions. Meantime, while under observation and while their symptoms were being studied with a view to their final disposition, they could be utilized for medical instruction precisely like any patients in general hospitals. Those who are connected with hospitals for the insane have often been distressed by the commitment of hysterical, neurasthenic and other improper patients who, had a detention hospital been provided, might have been treated according to general hospital methods and sent to their homes without the stigma of a commitment to a hospital for the insane as insane and irresponsible persons. In the same connection, I would urge the importance of providing at every general hospital an out-patient department for the treatment of cases of insanity by alienists rather than by neurologists. I regard such departments as most important adjuncts to the successful and useful treatment of psychiatry. I am persuaded that many neurasthenic, anæmic or melancholic cases might thus be seen

\*In this connection I would call attention to the method adopted by one of our most successful teachers of psychiatry, Dr. Cowles, of Harvard University. In a recent letter he presents a syllabus of his course, which covers in order Imperative Conceptions and Obsessions; the Laws of Nervous and Mental Mechanism; an Analysis of the Mental Symptoms of Nervous Exhaustion and of the Acute Psychoses, of the Essential Dementias, and of Organic and Degenerative Psychoses. He adds: "These indicate my conception of a method of teaching psychiatry, in which the guiding purpose is to put the student in possession of principles with a sufficient illustration by cases to make them clear. This method of teaching principles seems the better one for students taking up newly this subject."



and treated in the beginning of their disorders and cured without needing to resort to the hospital for the insane. Under present methods, however, the condition of such patients is not promptly recognized and they eventually come to the hospital for the insane at a stage of their disease which is not as favorable for cure. For a number of years I observed such a clinic in the out-patient department at the Johns Hopkins Hospital and was favorably impressed by its practical utility. Not the least of such utility is the opportunity which such a clinic affords for the instruction of medical students. I am convinced that there are several forms of mental disease which the alienist physician rarely or never sees in their early stages because the mental symptoms are not grave enough to justify the important and hazardous step of commitment to institutions. The medical student, however, should see them, because of the probability that his attention will be called to them when he enters upon medical practice. By the study of the symptoms of these patients under the guidance of the alienist physician the student becomes familiar with the proper investigation of mental cases and acquires an ability to win their confidence, to understand their morbid mental condition and to treat them rationally. An experience of several years in the general hospital has convinced me that neurasthenic and mental cases form an important part of those cases which physicians in general practice are called upon to treat. No medical teaching can be considered thorough or complete which does not furnish the student adequate clinical experience with such cases. The same is true of the training of nurses. Every well-trained nurse should have had experience in the care of mental cases. In no other manner can the student acquire a familiarity with the appearances of early mental disease. I am glad to be able to add that such a clinic has existed for some years in connection with the Pennsylvania Hospital and a similar one has recently been organized in Boston. I look forward to the time when every hospital which furnishes facilities for medical teaching will provide similar clinics for out-patients. I would emphasize most strongly the need of the study of insanity in its clinical forms by clinical methods, not to support preconceived theories or to reconcile seemingly inconsistent facts. We have a disease to deal with which is slow in its onset, protean in its manifestations, chronic in its course and which if uncured ends in dementia and mental death. What are its causes, the immediate exciting factor in its outburst, the order of its manifestations and development and the physical and mental phenomena characteristic of the entire course of the disease? As soon as these facts are ascertained and arranged and the pathological findings are studied in connection with the clinical history and in the light of the disease as a whole, I am sure that a rational explanation will be found for insane conditions and a line of treatment evolved which may increase our hopes of cure. Until this is done I have little expectation that any theory, however plausible, or any flight of the imagination, however brilliant will suffice to give us the clue. If the theory of a retraction of the processes of the neuron had a particle of evidence behind it we might explain some of these phenomena, but in the light of our present knowledge it seems worse than futile to depend upon it for a final

explanation of diseased processes. Medical science is a structure the building stones of which are isolated facts, which have been fitted together with infinite pains and after many errors and blunders. Many of the stones after lying in position for years and even centuries have been found wrongly shaped and have been removed from the wall to the great detriment of the superstructure. The aggregation of truth which constitutes the science of medicine has been slowly and painstakingly made and much has needed to be done over. If science were a growth from some great vivifying germinal truth, we might find it upon a brilliant theory or an illuminating generalization. Unfortunately, it is not an organic but a composite product. It does not grow like an oak from an acorn; it is not the logical result of *a priori* processes; it yields its truths to no open sesame; it knows no philosopher's stone by which theory can be transmuted into priceless truth; it is simply a collection of facts with deductions therefrom.

When the student has become familiar with the clinical features of ordinary insanity he should have an opportunity to recognize its terminal forms in large institutions for the chronic insane and an added opportunity to study the pathology of the disease. Afterwards, should come instruction in medical jurisprudence and in the varied relations of the insane to the law, the State and to society in general. Less than the course above outlined should not be thought of and more would not come amiss. It is gratifying to observe a growing tendency on the part of medical schools to furnish this instruction. I believe, however, if the minimum of requirements which I have outlined could be exacted in every medical school, we would find a growing interest in psychiatry and an increased willingness on the part of men of the first class to enter lunacy practice or to become connected with institutions for the care and treatment of the insane.

Thus much for the teaching of psychiatry to the general practitioner and to the ordinary student of medicine. The training of teachers and of experts in mental disease should, however, go far beyond what I have outlined.

For these, opportunities for special graduate study should be afforded at some one of the great medical centers of the United States, and preferably in connection with one of the Pathological Institutes. Here a training should be given in psychology and its methods of studying normal and abnormal processes. Anthropology should also be pursued to give a knowledge of the inheritances of the race and the characteristics of races and peoples, their modes of development, their folk-lore traditions and inherited beliefs. In passing, I would remark that in my judgment the careful study of this unwritten tradition which has been handed down from generation to generation, surviving both barbarism and civilization so-called, would throw much light upon the development of delusions and other manifestations of insanity. Many problems of heredity are best solved by the methods of anthropological study, as also the relations between degeneracy, criminality and insanity. Pathology and histology should also receive careful consideration, and neuropathology should be pursued to throw light upon the nutrition of the nerve-cells and their

relation to poisons from within and without. These and kindred studies are of the highest interest, and should engage the best minds of the medical profession. The soil to be tilled

has long lain fallow, but the harvest now should not long be delayed. The future of psychiatry is inspiring and full of promise.

## A NEW APPARATUS DESIGNED FOR THE SUPPORT AND SAFE ANAESTHETIZATION OF PATIENTS WHILE IN THE KNEE-CHEST POSITION.\*

BY CLEMENT A. PENROSE, M. D.

### IMPORTANCE OF THE KNEE-CHEST POSITION.

In the recent publication of Dr. Howard Kelly's magnificent work on operative gynaecology, the importance of the knee-chest position in the surgery of the bladder and rectum, is so thoroughly established that it is hardly necessary to emphasize it here other than very briefly. No other position allows of such complete expansion of these organs, thereby facilitating their examination, topical treatment and surgery. In this position, without difficulty, the entire mucous membranes of both bladder and rectum by means of headlight and speculum can be explored, areas of disease treated or removed, and the ureters catheterized, to determine their exact location as a preliminary in a complete hysterectomy, to drain and irrigate the kidneys, or to locate renal calculi with wax-tipped catheters, etc., etc.

### NECESSITY FOR ANAESTHESIA IN THE KNEE-CHEST POSITION.

Although of great service in a great number of instances without an anaesthetic, yet in a majority of cases anaesthesia is necessary to thoroughly relax the walls of bladder or rectum, to eliminate pain which is often extreme, as a preliminary to operations requiring an anaesthetic, in which case it is better, especially in nervous subjects, to do the whole under the one anaesthetization, and lastly, to relieve the feelings of the patient from the standpoint of modesty.

### OBJECTIONS TO ANAESTHESIA IN THE KNEE-CHEST POSITION.

When supported in the old fashion without apparatus, the patient with weight thrown on the chest and neck bent at right angles often becomes cyanosed, breathes with great difficulty, has a high pulse, and occasionally almost suffers collapse, especially if operations are at all protracted. The anaesthetizer holding a cone with one hand and supporting the patient's head with the other, has great difficulty in holding the jaw properly forward, and in keeping track of the pulse, and in fact, never feeling quite sure of his patient's condition or stage of anaesthetization. Two assistants, one on each side, are necessary, in addition to the anaesthetizer and a man to hand instruments, to support the patient in a correct position. In spite of such support, there is yet considerable mobility, the effort to control which is very tiresome for the assistants, and disastrous to delicate manipulation.

### REQUIREMENTS OF AN APPARATUS TO SUPPORT A PATIENT WHILE ANAESTHETIZED IN THE KNEE-CHEST POSITION.

1. One which allows of complete expansion of the bladder and rectum, specially the former; i. e., there being nothing in any way pressing on these parts as straps, supports, etc.
2. One which supports the chest and head in such a manner that breathing is not difficult and an anaesthetic is easily administered.
3. One which holds the patient absolutely immobile in the correct position without strain or any undue pressure, thus dispensing with an unnecessary number of assistants.
4. One which admits of patients being lifted on and off the table without difficulty or danger, while under the influence of the anaesthetic.
5. One which can be adjusted to various sizes of patients.
6. One which is not too elaborate or expensive.

That necessity is the mother of invention was possibly never more thoroughly demonstrated than in the motives which induced me to construct my apparatus. Any one who has had experience in the anaesthetization of patients while in the knee-chest position will appreciate in full the trials and tribulations of the anaesthetizer, as often in spite of the utmost care, his patients will become cyanotic and have a high pulse, and not infrequently operations are suspended owing to the sudden cessation of breathing and artificial respiration is required before they can be resumed, if completed at all. While in the service of Dr. Kelly I etherized a great number of patients in this position, and though never being so unfortunate as to lose one, had enough mental perturbation in several instances to induce me to speculate on some means by which an anaesthetic could be administered to patients in this position without additional danger. Encouraged by Dr. Kelly, who kindly offered me every facility for experimentation, I made in the summer of 1897 a crude apparatus of wood which in its essential features resembled the one now reported. This was used constantly and with gratifying success. A number of patients, twenty-five or thirty, in the course of a few months were etherized and placed on this apparatus, and among this number not one took the anaesthetic badly, nor was it necessary in a single case to hasten or bring operations to a close, owing to the condition of the patients, who, in fact were kept a much longer time on my apparatus, in several instances one half hour or more, than when held up by assistants after the old fashion. The apparatus presented to the Society this evening, consisting principally of steel, has been in constant use in the Gynaecological Department of the Johns

\* Read before the Medical Society of the Johns Hopkins Hospital, January 23rd, 1899.

Hopkins Hospital for over one year, and I understand has given great satisfaction.

In light of these most encouraging results and of the increasing importance of the knee-chest position in surgery, it may safely be predicted that if by its use the chief element of danger be eliminated, i. e., the administration of the

anaesthetic, major operations on the bladder and rectum of several hours' duration may be performed. Day by day the importance of certain procedures in the knee-chest position, both from a diagnostic and curative standpoint is becoming more manifest, and necessarily an apparatus which furthers such manipulation is of the utmost importance to humanity.

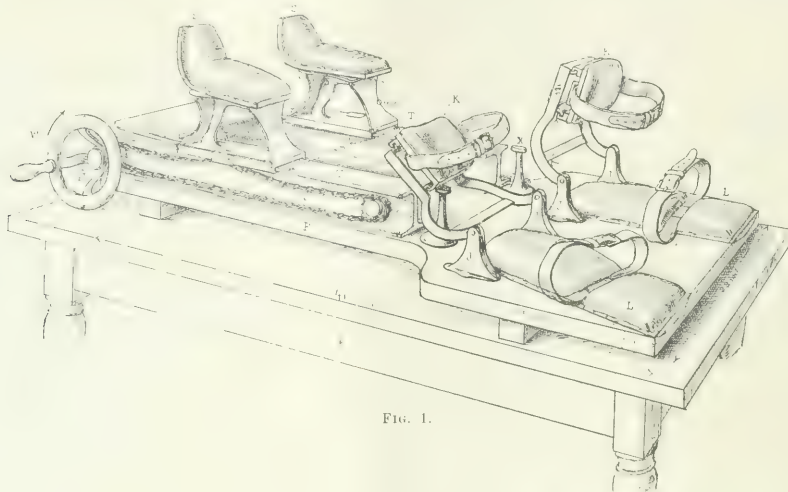


FIG. 1.

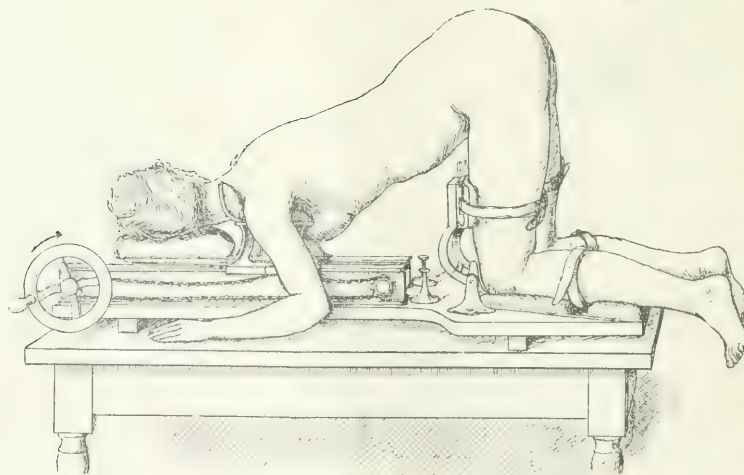


FIG. 2.

The careful drawings made for me by Mr. H. Becker, are exact representations of my apparatus without and with a patient in position. (See Figures No. 1 and 2.)

In Figure 1, the exact measurements of the apparatus are given, and a very good idea of its construction, which is exceedingly simple, and its ease of adjustment. In brief, it

consists of two shoulder supports, S, S, with cushions of leather which can be moved sidewise by a screw in front, not shown in the figure, to accommodate varying widths of shoulders. These supports run on a track, T, T, being connected with a chain, C, C, which is moved by a wheel, W. A ratchet wheel with a pull on the inner side of wheel, W, not



shown in the figures, allows only of rotation in the direction of the arrow, unless the pall is released. K, K are supports which press against the front of the thigh, the cushions of which also have a motion sidewise and are held firmly in place by straps. J, J are joints corresponding to those of the knee; L, L are cushions on which the tibiae rest, with straps passing over the calves of the legs.

Figure 2. shows the patient pushed up into the correct knee-chest position. She has first been etherized on a bed or stretcher until completely relaxed. The apparatus placed on a table made especially for the purpose, and at a height desired by the operator, is then adjusted to accommodate the size of the patient. As a rule the same adjustment works for most patients unless they are very large or small. She is then lifted up and placed face downward on the apparatus, the shoulder pieces supporting the shoulders, the body being only slightly flexed. The thighs and calves are then strapped with the straps firmly to their respective cushions, and the pall being thrown on to the small ratchet wheel, the large wheel W is turned in the direction of the arrow and the patient is slowly pushed up into the correct position. A cushion can be placed on the head piece, H, which is connected to the shoulder supports, S, S, but can be detached in a moment, giving ample room between the tracks for swabbing out the mouth, holding the jaw forward, etc., etc. With the head turned slightly to one side, the anaesthetic is administered as easily as when on the back, the chest has free room for expansion between the shoulder supports, which keeping the shoulders well back are an assistance rather than otherwise to deep inspiration. The abdomen, hanging pendulous and unsupported, admits of full dilatation of both bladder and rectum with atmospheric air. Sheets, towels, etc., are readily draped in such a manner that parts for examination or operation alone are exposed.

In conclusion I would like to say that owing to the great number of patients in the surgical clinics of our large hospitals, there is a tendency to discard what may take up precious time. All experienced anaesthetizers know how much better a patient takes an anaesthetic who at first has been given it slowly with words of encouragement and suggestion spoken here and there, than those who have been badly frightened by having a cone clapped down over the face and the anaesthetic forced before becoming unconscious. The desire to save time, unfortunately among the less experienced, has made the term "a quick anaesthetizer," a synonym for a good anaesthetizer, whereas the proper and only just criterion should be the condition of the patients during the operation, when returned to the ward, and lastly, the opinion the patients have of the anaesthetizer. The conditions favoring the prolongation of the period of anaesthesia are as important as those which are desirable when a patient is going under the anaesthetic. It does take a few moments longer to place patients correctly on my apparatus than to lift them up and support them in the knee-chest position by main strength, and I might add, in many cases with awkwardness. One or two minutes are well lost if our patients run less risk, and much time is eventually saved by not having recourse later to strychnia, salt infusion, artificial respiration, etc., after operations are begun.

If placed properly on this apparatus, I feel certain that patients can be kept under an anaesthetic for as long a time in the knee-chest as in the Trendelenburg position. As but one assistant in addition to the anaesthetizer is required, the others formerly employed may be utilized in getting other cases ready for operation, etc., and thus save time.

The utility of this apparatus having been already tested for over one year in Dr. Kelly's clinics, and in many cases, I feel a much greater confidence in recommending it to those using the knee-chest position for examination or surgery.

## PROCEEDINGS OF SOCIETIES.

### THE JOHNS HOPKINS HOSPITAL MEDICAL SOCIETY.

#### A Case of Hemochromatosis. DR. O'NE.

The patient, a man aged 55 years, was apparently in good health until about six weeks before his death, when he was taken with symptoms of typhoid fever. When seen two weeks later, rose-spots were well marked over the abdomen, and there was elevation of temperature and extreme weakness, a most striking feature being the extreme pigmentation of the skin, which was of a brownish color and most marked about the nipples, genital organs and the backs of the hands, strongly suggesting Addison's disease. The urine at no time showed sugar, the first examination being made about four weeks before death, and, subsequently, on several occasions, the last about three days before death. The autopsy was performed about nine hours after death. The body was that of a very much emaciated man, with pigmentation extremely well marked. On opening the abdomen there was found pigmentation of the parietal peritoneum; the liver was cirrhotic and

presented a marked brownish pigmented appearance; the pleural cavities showed no evidence of inflammation; the heart was sound and not increased in size, the muscle having a yellowish-brown color; the lungs were normal, except for bronchopneumonic areas; the spleen was enlarged and very soft, with no evidence of any extreme pigmentation. The gastrointestinal tract showed extreme pigmentation more marked in the duodenum and stomach than in the ileum and jejunum, but again there was well-marked pigmentation in the large intestine. The pancreas, of a chocolate-brown color, showed thickening of the capsule and septa extending into the organ. The adrenals were of normal size and showed nothing abnormal. The kidneys were not markedly pigmented, but somewhat cloudy. The lymph glands throughout the abdomen were enlarged and presented a very brilliant brownish orange-yellow appearance. In the lower part of the ileum there were ulcers with clean bases confined particularly to the Peyer's patches. Cultures made from the heart's blood showed pure typhoid bacillus, which was also present in the liver and

gall-bladder, with lactic aerogenes in the lungs and kidneys, and colon bacillus in the pancreas.

The case, then, was one of typhoid fever, with pigmentation of the various organs, notably the liver, pancreas, heart and gastrointestinal tract, associated with cirrhosis of the liver and chronic interstitial pancreatitis.

Bands of connective tissue separated the liver lobules one from the other, and there was slight invasion of the periphery of the lobules. From the central vein bands of connective tissue extended between the columns of liver cells. The most striking feature was the abundant deposit of pigment throughout the tissue. Occasionally the whole cell body is filled with pigment, and in the most extreme cases there is evidence of cell-degeneration; the nucleus becomes shriveled and loses its staining properties, becomes very pale and finally disappears, leaving a clump of granules, still retaining the outline of the cell. This pigment, when treated with ferrocyanide of potassium and hydrochloric acid, gives the Berlin blue reaction, characteristic of iron.

In addition, there is a second form of pigment which gives no iron reaction. It is in the form of small granules of brighter yellow color, and is deposited in the smooth muscle cells of the blood-vessel walls, particularly the portal vein, and in the connective-tissue cells in the sheath of the vessels.

Iron-containing and iron-free pigment was also present in sections of the pancreas, while in the heart the iron-containing pigment was present in great quantity in the muscle cells. In the gastrointestinal canal the iron-containing pigment was present in small quantities, but the iron-free pigment in great quantities, in either the smooth muscle cells or in the connective-tissue cells. The greatest quantity in the stomach was deposited in the most internal portion of the circular layer. Other organs showed a less degree of pigmentation. In the lungs, here and there, were found connective-tissue cells which contained the iron-containing pigment. In the lymph glands was found a great quantity of the iron-containing variety, which was present in the form of extracellular globules of varied size, the pigment almost entirely replacing the gland substance, very few of the lymph cells being seen. The case then shows throughout the internal organs a deposit of two forms of pigment. Within the gland cells, notably in the liver, pancreas and heart muscle cells, there is the iron-containing pigment, while in the smooth muscle cells of the blood-vessels and the gastro intestinal canal, as well as in certain connective-tissue cells, there is a deposition of the iron-free pigment.

Under the designation "haemochromatosis" Von Recklinghausen, in 1889, described a condition of macroscopic pigmentation of various organs due to the presence in the tissues of a brown pigment derived, he thought, from the haemoglobin of the blood. An iron-containing and an iron-free pigment were found in situations corresponding to those cited in the foregoing case; cirrhosis of the liver was present. Other writers have subsequently described cases of haemochromatosis. A condition of pigment accumulation in the internal organs associated with diabetes and hypertrophic cirrhosis of the liver has been studied particularly by French writers, who on account of the well marked skin pigmentation usually present

have given it the name "diabète bronzé." While in many of the early cases an iron-free pigment, being less conspicuous than the iron-containing variety, was overlooked, in several more recent both varieties have been found and their location has been that characteristic of haemochromatosis. The pigmentation of bronzed diabetes may, therefore, be regarded as identical with that of haemochromatosis.

It cannot be doubted that the large quantity of iron-containing pigment present in the tissues is derived from the haemoglobin of the blood set free by the disintegration of the red blood-corpuscles. Several cases of haemochromatosis associated with purpura have been reported, while others have presented local haemorrhagic conditions, for example, haemorrhagic pleurisy or pachymeningitis, indicating perhaps some pathological condition of the blood. Nevertheless, in a considerable proportion of the cases observed, including that just described, there has been no evident blood-destruction.

In the cases of bronzed diabetes there two factors present—one, the diabetes with glycosuria, and the other the hypertrophic cirrhosis of the liver. In ordinary cases of diabetes there is no tendency to the deposition of an iron-containing pigment, and there is no evidence that in diabetes there is a marked blood-destruction. The liver suggests itself as a possible origin of the iron-containing pigment, but if the pigment is formed in the liver, it must be carried to the other organs in the form of emboli, and there is no evidence of the occurrence of such emboli nor is there any evidence of phagocytic cells carrying pigment to other organs. The deposition of pigment in the various organs, the heart and pancreas, for example, takes place by just the same method as it does in the liver, so that it seems more reasonable to suppose that the pigment is formed in the cells in which it is found, rather than that it is formed in the liver or other organs and carried to more distant parts.

In association with the accumulation of pigment in the liver there is often cell-degeneration and cell-death, and accompanying this cell-death there is an increase of connective tissue. It seems plausible to believe that the cirrhosis and the inflammation of the pancreas are a result of the death of the cell following the deposition of pigment.

In all cases of bronzed diabetes which have been described there has been found a chronic inflammation of the pancreas. The fact that the chronic interstitial pancreatitis is an etiological factor in the production of diabetes has been pointed out by many observers. The diabetes in these cases seems to be a result of the chronic inflammation of the pancreas and to be a terminal event in the haemochromatosis. The original factor, then, would be some blood-destroying cause, which in many cases is very obscure. Following this blood-destruction there is a formation of iron-containing pigment, which is deposited in various portions of the body; with this deposition of iron pigment there is a cell-death, and a consequent interstitial inflammation of certain organs, particularly of the liver and pancreas. When the pancreatitis has reached a certain degree of intensity, it seems possible to believe that there is an onset of diabetes, thus accounting for the diabetic condition in the bronzed diabetes described by some of the French writers. In the foregoing case the patient's death was caused

by typhoid fever before the pancreatitis had reached a sufficient intensity to cause diabetes.

# DISCUSSION.

Dr. WELCH:—This is the first instance I have seen of this condition, and about all I know of it is from a study of Dr. Opie's specimens. It has interested me very much indeed and he has said I think practically everything that can be said as to the interpretation of the condition.

I should judge from what I have read of the literature that it is impossible to explain the condition as the result of the formation of pigment from haemorrhages and equally impossible to explain the pigment as being formed in one organ and transported to other parts of the body. Dr. Opie has made very clear the objections to either of those explanations and also the conception of the condition as a disease by itself—a haemochromatosis with change in the liver, pancreas and elsewhere as secondary symptoms. It hardly seems easy to understand how mere destruction of red blood-corpuscles which occurs in many conditions can be an adequate explanation. We have in other conditions, as in pernicious anaemia, extreme destruction of corpuscles and a deposit of pigment, but not like this. The chemistry of the process must be somewhat different from ordinary destruction of the blood. Otherwise how can we account for the fact that this is a definite and peculiar disease whereas the mere destruction of the red corpuscles, following definite lines, does not produce the condition? May not the destruction of the corpuscles, although we can not define the character of it, be a peculiar kind of destruction?

Dr. OSLER:—The condition has interested me much in connection with the question of cutaneous pigmentations apart from Addison's disease. We have had a very interesting series of cases within the past few years, two in connection with hypertrophic cirrhosis. One case, a young man upon whom Dr. Halsted operated under the supposition that he might have a tumor in the liver, proved to have a hypertrophic cirrhosis with an extreme degree of pigmentation of the skin. A fourth case of hypertrophic cirrhosis has recently died in West Virginia and specimens of the liver were sent to me and I would ask Dr. Opie to examine them. This case also presented an extreme degree of pigmentation. Two of our cases of enlarged spleen have had considerable degrees of staining of the skin. Occasionally in pernicious anaemia you meet with a degree of pigmentation that looks like Addison's disease and you are in doubt as to the nature of the case. Finally, you have certain instances in which you can not account in any way for the profuse pigmentation of the skin as is the case with the man present now in the ward. He has chronic pericarditis and has not the three cardinal symptoms of Addison's disease.

It seems to me a little doubtful, considering the variety of conditions, in which widespread pigmentation can occur, whether we should accept the view that it is a separate and distinct disease, particularly when we know that pigmentation does occur so often with cirrhosis.

Dr. OPIE:—It may be said in answer to Dr. Welch's question

that there seems to be some condition necessary to the production of the cirrhosis and pigmentation in addition to the mere destruction of red blood-corpuscles. There have been various attempts to reproduce the pigmentation of haemochromatosis by the injection of substances which cause breaking down of the red corpuscles. Toluylenediamin has been injected subcutaneously into dogs and the organs studied later. In such cases a pigment having the characteristics of haemosiderin is formed in the liver but it is present in moderate degree and cirrhosis is not produced. Attempts to reproduce a condition of general pigmentation by such methods have failed. Recently Kretz has studied a series of cases of cirrhosis of the liver and in about one half of them has found the deposition of an iron-containing pigment in large quantities in the liver. He comes to the conclusion that with certain varieties of toxæmia there is a destruction of the liver cells producing cirrhosis and at the same time this poison, whatever it may be, circulating in the blood, causes a destruction of the red corpuscles. In this combination of blood-destruction and injury to liver cells he finds a favorable condition for the deposition of an iron-containing pigment. This is for the most part theoretical.

## Report of a Case of Combined Typhoid and Quartan Malarial Fevers. Dr. CRAIG.

In the absence of Dr. Craig, Dr. Thayer presented a report of the following case, which occurred at the Sternberg U. S. A. General Hospital at Chickamauga Park.

Dr. P. had suffered from September 29 to October 5, from general malaise, constipation and headache, with an even temperature from 101°F. to 102°F. Although feeling ill, he did not take to his bed until October 5, 1898, when he was admitted to the hospital, complaining of a severe headache and great nervousness. The previous evening he had had a slight chill. On admission, he presented the following clinical symptoms: Gurgling, and much tenderness in the right iliac fossa, a dry, hot skin, brilliant eyes, with injected conjunctivæ, and a typical typhoid tongue. The typhoid symptoms gradually increased and he had tympanites, epistaxis, rose-spots, extreme restlessness and a slight bronchitis.

October 12, or about the twelfth day of the fever, his blood was tested by Widal's test and gave a very pronounced reaction, while the urine showed the diazo-reaction very markedly. The patient had never suffered from typhoid fever previously.

Until October 15 the patient continued to present the characteristic picture of typhoid fever, his temperature ranging between 101°F. and 104°F. Baths were given, but they reduced the temperature only a little, and the patient's condition was grave. On October 15, the temperature in the morning had fallen to 100°F., the patient's general condition being very much improved, when he had a slight chill, with a rise of temperature to 103.4°F. The attending physician thought little of the chill, as by evening the temperature had fallen to 101°F., and for the succeeding two days ranged between 100°F. and 102°F. October 18, however, just 72 hours after the first chill, a second and more severe chill occurred, the temperature rising to 104°F. At this time I was called upon to examine the blood, and found the quartan



malarial organism in abundance. The details of this examination will be given later. The patient's general condition was markedly altered for the worse, he being very weak and tremulous, having great general pain and a poor irregular pulse.

From October 18 to October 21 his temperature ranged between 98.8°F. to 100.6°F. The administration of quinin in small doses (5 grains night and morning), was begun October 18. October 21, a third paroxysm occurred, but was delayed somewhat, (probably by the quinin), so that it extended into the 22nd, the acme of the fever being reached by 4 a. m. of that day. This paroxysm was very severe, the chill lasting 30 minutes, and the temperature rising from 99.2°F. to 104.6°F. A fourth paroxysm occurred October 25. For some reason the quinin had been stopped upon the 23rd. A fifth paroxysm occurred October 28, after which time quinin in large doses (10 grains every 4 hours) was given. October 31, a very slight chill occurred, with a rise of temperature to only 102°F.

From this time the patient had no further paroxysms, and his temperature remained normal. The convalescence was very slow. During the malarial complication the patient's condition was that of a desperately sick man, and none of the surgeons who saw him entertained any hope of his recovery. He became extremely emaciated and anemic, and was delirious much of the time. During the whole time, his blood showed numbers of quartan plasmodia, corresponding in their development with the time of the paroxysms. The blood also gave a pronounced Widal reaction whenever tested.

Microscopical examination of the blood.—The blood was first examined at the time of the second chill, when numerous full-grown and segmenting quartan organisms were found. Examinations were made every day, and plasmodia were always easily found. The last plasmodium seen in the blood was on November 31, a full grown quartan organism.

A record of four days, which follows, shows the average findings for that period throughout the course of the fever:

October 18, chill. Large number of full-grown organisms, a few segmenting bodies, fragmenting bodies, and extracellular bodies, and a few hyalin bodies.

October 19. Numerous hyalin, unpigmented bodies, small pigmented bodies, and one fragmentation form.

October 20. Many half-grown and nearly three-quarter grown pigmented quartan organisms, a few vacuolated.

October 21, chill. Many full-grown organisms, several segmenting bodies, and fragmentation and extracellular forms.

Study of the type or organism.—The smallest forms resemble the tertian hyalin form exactly, being amoeboid, though rather less so than in the tertian variety, and occupying generally one or the other side of the corpuscle. As they grew, however, the outlines became more clearly cut than that of the tertian, their movements were slower and their protoplasm presented a very refractive appearance and looked as though it might be finely granular. At this time the pigment began to appear as very dark, rather coarse dots and grains, which were very sluggishly or not at all motile. The shape of the organism at this stage altered very little and very slowly. The red corpuscles containing the organisms were noticeably smaller than the uninfected ones, and were generally of a dark-greenish

color. When full-grown, (about 68 to 72 hours old), the organisms had clearly cut outlines, were oval or round in shape, and occupied about two-thirds of the infected corpuscle. The pigment was collected at the edge of the organisms, was almost immobile and dark and coarse. The segmenting bodies, which were always present at the time of the paroxysm, were very characteristic. The segments numbered from 6 to 12, the pigment was collected in the center in one solid, dark block, or in a radiate manner, and nearly all were beautifully regular in their arrangement. Degenerate forms were often observed, in which fragmentation and vacuolization had taken place. No flagellate forms were observed. Peculiar oval extracellular forms were noticed, in which the pigment was motionless. There can be no doubt that the organisms belonged to the quartan type, and there never was a time during the active course of the fever that these organisms could not be demonstrated in the blood, although they disappeared rapidly after quinin in sufficient dose had been administered.

Up to October 15, the twenty-second day of the disease, the course of the fever had been typically typhoid and the temperature curve had begun to decline gradually, as is characteristic of that disease. On the 22nd, following the chill, the temperature rose, but instead of falling to normal or below fell only to the point held previously by the original disease. From that time a gradual decline took place until the second chill, on the 18th, when the temperature rose from 99.4°F. to 104°F., but fell in the course of 4 hours to 99°F. If we leave out the rise of temperature due to malaria, the course of the temperature is that of a typically declining typhoid, which holds true up to the 24th, when the temperature between the malarial paroxysms became very irregular. Prior to the 24th the temperature curve illustrated most instructively how these two diseases, which existed together, influenced the temperature chart.

In the latter part of November, when the Sternberg Hospital was closed, the patient was transferred to another hospital, where he died.

#### DISCUSSION.

Dr. OSLER:—I believe this is the first instance in which the quartan infection has been demonstrated in connection with typhoid, is it not?

Dr. THAYER:—Yes.

Dr. OSLER:—This then completes the history, for the estivo-autumnal and tertian varieties have been repeatedly found. I arise again to enter my protest against the term "typhomalarial" for these infections. We do not speak of dysentery-malarial or pneumo-malarial and we should not speak of typhomalarial. The malaria does not seem to influence the course of the typhoid.

It would be interesting to compare this case with the remarkable case of pseudo-typhoid that is now in the ward. During the whole course of the disease chills have occurred associated with profuse sweats, and I do not suppose any one without careful examination would doubt the diagnosis of malaria in such a case, were it made, though I think the evidence at present is strongly in favor of its being typhoid.

Dr. THAYER:—I think the reports that are gradually coming in from various military hospitals with regard to the fre-

quency of these combined infections are rather interesting. Early in the fall and summer the papers were full of statements that cases of combined malaria and typhoid were very frequent and it was said that ten or fifteen, perhaps even twenty per cent. of all the cases were of the combined type. As the accurate reports are received, it is surprising to me to find how few cases have occurred. The conditions that existed in the army camps, in Cuba and in the South, were the ideal conditions for malaria and typhoid to develop together. One would expect that a very considerable number of cases of combined infection should occur, but as a matter of fact such cases seem to have been relatively few. Dr. Norton noted the fact that many cases of typhoid fever at autopsy showed evidences of preceding malaria, but he did not remember, I think he said, a single instance where they were positively found in the hospital. I think we may say safely that the actual course of typhoid fever is very little influenced by the combined infection with malaria. When the two diseases occur at the same time the condition of things seems to be very much that shown in Dr. Craig's case, the malarial symptoms are simply imposed upon those of typhoid. They may aggravate the disease and make the patient feel worse, but they do not affect the course of the typhoid itself, and we must absolutely abandon the name typho-malarial as suggesting a combination of the two diseases.

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# BULLETIN

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## THE RECOGNITION OF THE POISONOUS SERPENTS OF NORTH AMERICA.\*

BY HOWARD A. KELLY, *Professor of Gynecology The Johns Hopkins University and Gynecologist-in-Chief The Johns Hopkins Hospital.*

I have felt an interest in snakes since boyhood, but the more practical duties of life have prevented my following this penchant for over twenty years. It becomes now, however, my pleasure to brush up the forgotten lore in order to put before you certain facts I think you should all master before graduation. If our medical curriculum were not already crowded, I should urge a brief course of lectures year by year, followed by an examination, upon the subject of the various poisonous insects and animals and their antidotes; for to whom shall the victim of injuries sustained in this way appeal for accurate information as to the danger from a given bite or sting and the identification of the species causing it, as well as the proper treatment, if not to you?

I shall speak briefly this evening of one group of poisonous animals—the snakes; and it shall be my effort to impress upon you such details of their structure that you shall be able to decide with certainty whether a given species submitted for your examination is or is not poisonous.

In classifying and identifying the various species you will find somewhat useful, although often confusing, Baird and

Girard's Catalogue of North American Reptiles in the Museum of the Smithsonian Institution, Part I, Serpents, published in 1853; Jordan's Manual of the Vertebrates in the Northern United States, 1899, is most valuable, and Leonhard Stejneger's work on the Poisonous Snakes of North America is indispensable; the last-named work published by the government for the Smithsonian Institution really ought to be in the hands of every physician in the land. Dr. Yarrow, of Washington, one of our most eminent authorities, has written numerous treatises, including an article in Wood's Reference Handbook of the Medical Sciences. Other works are a Catalogue of Snakes in the British Museum, in three volumes, by Boulenger, London, 1893; Herpetologia Europæa, by E. Schreiber, Braunschweig, 1875, and Deutschland's Amphibien und Reptilien, by B. Dürigen, Magdeburg, 1897.

Snakes are reptiles distinguished from batrachians (the frog family) by the fact that they undergo no metamorphoses and do not pass through a tadpole stage of existence. Snakes either lay eggs and are oviparous, or they produce their young living from eggs hatched but a short time before inside the mother, when they are ovoviviparous; they are distinguished from the lizards by possessing widely dilatable mandibles and the fact that the head-bones are united by ligaments, while they possess no limbs or shoulder-girdle, and have no eyelids

\*An address with a demonstration to the Graduating Class in the Medical School, before the Johns Hopkins Hospital Medical Society, November 6th, 1899.

and no external ear or tympanum. In boas there are little rudimentary hind limbs.

The body of the snake is covered with scales arranged in rows down the back and on the sides; large transverse overlapping scales in a single row cover the belly. The head, as in the lizards, is covered with a series of large plates which are constant in their arrangement in the same species, and therefore important aids in classifying and identifying species.

One might suppose from this statement that nothing would be easier than to determine whether or not a given animal is a snake; there are, however, several little animals which are popularly considered as snakes which belong in other orders. I show you here for example an animal, the *Amphiuma* means, widely known as the "Congo snake," and looking much like an eel, but able to live a long while out of the water. On close inspection you will discover four short rudimentary limbs with little toes, and on each side of the neck there is a spiracle. In walking the *Amphiuma* uses these feet, useless as they appear to be, as I have frequently had occasion to observe in this specimen which I kept alive for some time. It is one of the tailed batrachians, and therefore much more closely allied to the frogs than to snakes.

While the *Amphiuma* comes from a lower order than the snakes and much resembles a fish, I show you here on the other hand a beautiful lively little animal everywhere known as a "glass snake," the *Ophisaurus ventralis*, belonging to the family of the lizards, which has a long cylindrical snake-like body closely covered by overlapping scales; it is over two feet in length, without any trace of limbs, and necessarily adopts the same mode of progression as snakes. The *Ophisaurus* is, however, distinguished from the snake, upon closer examination, by solidity of the head, the well-defined ear-openings near the angle of the jaw as well as the distinct eyelids. It has also this distinguishing characteristic: the vent lies about one-third of the length of the animal back of the head instead of nearer the tail. I received this fine specimen from Dr. John C. Rodman, of Wilmington, N. C., who writes me that its captor told him that if struck with a whip it would break into a number of pieces, which if let alone will come together again in the course of an hour.

The *Ophisaurus* is a gentle and perfectly harmless little creature, and so is the Congo snake, which feeds on worms and crawfish. There is in the whole world no known poisonous member either of the batrachians or of the lizard family, popular superstition to the contrary, with the single exception of these two large lizards which I here show you, the Gila monsters (*Heloderma suspectum*), received from Dr. John S. Pearce, of Albuquerque, N. M.

They are so sluggish that I have never seen them attempt to bite; the most they have done in the couple of months they have been in my possession has been to crawl slowly around their cage and eat the eggs on which I feed them.

Among the true snakes, the Ophidians, we must distinguish carefully those which are poisonous from those which are not, and not be misled by a widely prevailing notion that all snakes are poisonous and ought therefore to be destroyed. As an example of the misfortune of ignorance on this head, I may cite the experience of a prominent Baltimore doctor who,

while fishing in one of the rivers near town and letting his hand hang in the water, was bitten by a harmless water-snake (probably *Tropidonotus sipedon*), and for fear that he was poisoned he immediately consumed a large amount of whisky to act as an antidote.

No ophiologist I know of takes the ground that poisonous snakes should not be destroyed, but the ignorance which leads people to destroy all snakes alike does not tend, as they think, to promote the extermination of the poisonous species, but in fact actually tends to preserve them, as their worst enemies are some of their own congeners of the harmless species, such as the black and the king-snakes (see Fig. 1).

The ignorant prejudice which leads people to destroy snakes indiscriminately tends further to seriously disturb the balance of nature by favoring the increase of the small animals upon which they naturally feed, such as toads and frogs and particularly the destructive field-mice which are consumed by thousands.

With a view, therefore, of giving you this information, which may at any time become a matter of vital importance to your patients, as well as with an earnest desire to save the innocent species, I shall now point out to you certain differential points between the poisonous and non-poisonous forms by which they may be most readily distinguished.

Fortunately the poisonous species are few in number and readily distinguished after one has once carefully noted some of their characteristic marks.

The poisonous snakes of this country, with the single exception of the little harlequin-snake (*Elaps*) of Florida and the South, belong to the group known as "pit-vipers," that is to say, they possess a curious conspicuous blind depression, which is a prominent anatomical characteristic in the fore part of the head over the upper lip between the eye and the nostril in what is known as the loreal region. This pit is hollowed out in the thick short superior maxillary bone, which here has the sole function of supporting the poison-fangs. Zoölogists have never been able to determine the function of the pit; Professor Leydig, finding it supplied with a large nerve not unlike the nerve of the eye and of the ear, has concluded that it is the organ of a sixth sense. The pit-vipers differ from the harmless snakes further in that their heads are triangular, with massive maxillary development expressive of great muscular power in the jaw; they have fewer large scales on the head, and a greatly increased number of small scales taking their place, giving the head more of a warty appearance. The snake is thicker in proportion to its length and has a shorter tail, and the dorsal scales are keeled, making the surface conspicuously rough. The pupil is elliptical. If the mouth is opened, the usual number of small teeth are seen in the lower jaw, while, above, a row of recurved short teeth is seen well in towards the centre of the head; these are the palatal teeth, while just outside of these, under the lip and well toward the front are two long mucous folds which hang like veils over the powerful recurved fangs which lie concealed with a number of smaller reserve fangs behind them. If the snake is living, as in the case of the copperhead which I now show you, he is apt upon touching the fangs to throw one or both forward, projecting and erecting them as in striking; further if the edge of a saucer or a watch-glass such as I hold

here is placed under the fang, a convulsive movement may be started by which the animal endeavors to thrust his fangs into the object and then rotates the maxillary bone inwards so as to bring them violently towards the gullet with the ejection of a few drops of the clear yellow poison. In a large diamond-back rattler a teaspoonful of poison may be ejected. For a description of the mechanism see S. Weir Mitchell's report to the Smithsonian Institution.

The poison-fangs are shed from time to time; I show you one dropped a few days ago in my library by this large banded rattlesnake, which is also just about to shed the opposite fang, which I now remove.

I will now characterize the pit-vipers a little more closely by stating that there are three genera with somewhere about 18 species, and all but two of these belong to the rattlesnakes, which are easily recognized by the caudal appendage.

The genera are *Agkistrodon*, *Sistrurus* and *Crotalus*.

The two snakes to which I now call your attention are the copperhead and the water-moccasin, both belonging to the same genus, *Agkistrodon*, and known respectively as *Agkistrodon contortrix* and *Agkistrodon piscivorus*.

The distribution of the copperhead (*Agkistrodon contortrix*), says Stejneger, "in a general way is coextensive with that of the banded rattlesnake (*Crotalus horridus*), though as a rule it does not extend quite so far north. As a compensation it goes considerably farther south in the western portion of its range, extending into the southern part of Texas."

I exhibit here two well-developed adult copperheads, received from Dr. Rodman, of Va., and Dr. Goss, of Georgia. The color as you see is a light chocolate, with wave-like dark alternating patches on the sides, the belly is yellowish; there are twenty-three rows of scales from side to side, all strongly carinated. The copperhead I think the handsomest of all our snakes. The arrangement of the scales on the head can be seen in the drawing made by Mr. Becker; the particular point of difference here between the copperhead and the moccasin lies in the presence of the loreal plate in the copperhead, and its absence in the moccasin (see Figs. 2 and 3).

Although vicious and usually striking without warning, the copperhead is not so dangerous as the rattlesnake when the poison is taken volume for volume; its bite is also less liable to prove fatal, as the snake rarely exceeds three feet in length, and the amount of poison available at any given time is much less than in the larger rattlesnakes.

The moccasin (*Agkistrodon piscivorus*) is distinctively a water-snake, and is of dark greenish brown color, sometimes almost black, variegated by a series of darker but indistinct bars. The twenty-five rows of dorsal scales are carinated. The lower wall of the eye is bordered by the third labial plate, counting back from the rostral in the middle of the upper jaw (see Figs. 4 and 5). The loreal plate is absent. The moccasin, or cottonmouth, as it is often called, can easily be distinguished from other snakes by the following marks: In the first place, its general configuration broad in proportion to length, the triangular head, the thick jaw, suggest at once that it belongs to the vipers; a closer examination shows that it possesses the characteristic pits between the eyes and the nostrils, settling the fact that it is a pit-viper. It then

only remains to distinguish it from the group of rattlesnakes on the one hand, which is easily done by the absence of the characteristic caudal appendage; and on the other hand from the copperhead, its closest ally, and this is easily done by the remarkable difference in color, the copperhead being of a lustrous copper-color, while the markings of the water-moccasin are all more or less obscure, and it possesses no beauty of coloration.

A further distinguishing and characteristic mark is a narrow yellowish white line beginning below the eye and passing backward and crossing the angle of the mouth at the seventh labial, as shown in Mr. Becker's drawing.

Although there is everywhere felt a wholesome dread of the moccasin, and Jordan calls it "the most dangerous of our snakes," I know of but one recorded fatality. Dr. J. R. Hopkins, of Hopkins, S. C., tells me that the cattle in his country are sometimes bitten when drinking in the branches and return with their heads much swollen.

I will be brief in considering the rattlesnakes, so easily recognized by their specific appendage, the rattle at the end of the tail. There are two genera, *Sistrurus* and *Crotalus*; *Sistrurus*, at the time I last took an active interest in snakes, was known as the little rattlesnake, or the prairie-rattler, belonging to the genus *Crotalophorus* or *Caudisona*. The two species, inhabiting the United States, recognized by Stejneger, are the massasauga (*Sistrurus catenatus*), and the ground-rattlesnake described by Linnaeus (*Sistrurus miliarius*). Although there is a popular dread of these animals, there is reason to question whether their bite is ever fatal.

In the form of the head and its broad plates, the snakes of this genus are more nearly allied to the harmless *Colubers* than any of the *Crotalids*.

I have here three living rattlesnakes representing two species: the first two are specimens of *Crotalus horridus*, the banded rattlesnake; one of these, so black as to scarcely show any markings, comes from central Pennsylvania, while the larger snake, 50 inches in length and 7½ in circumference, is a beautiful specimen from Dr. Goss, in Georgia; he has buff, finely mottled background, crossed at frequent intervals by rich velvety zigzag lines from two to three scales in breadth. In order to emphasize the remarkable contrast between these poisonous vipers and some of the harmless snakes, which I shall produce presently, note that of the entire 50 inches but 4 inches is tail. All the rattles of this larger snake have been lost, so that when he vibrates his tail as now there is no sound whatever unless the end of the tail strikes a hard or dry surface; this disposes of the common notion that the number of rattles is any indication of the age of the animal; note also, as I open the mouth, that the fang of one side has been shed, and the other is just ready to drop into the watch-glass which I hold under it.\*

The curious pit, so distinctive of our vipers, is well defined and measures 5 millimeters in depth.

I also show you here another beautiful *Crotalus*, received from Oklahoma, through Mrs. J. W. Putts of this city, 43½

\* Two large new fangs were found in position, ready for service, two weeks later.



inches long, powerfully built in proportion to his length, with six rattles which are vigorously agitated at the slightest provocation. I have had some difficulty in identifying the species. Dr. Stejneger, of Washington, however, decides that it is the prairie-rattlesnake (*Crotalus confluentus*), which, in some specimens, shows more green. The ground color, in remarkable resemblance to the sage-bush of the prairies, is of a yellowish green broken by a series of dorsal oblong blotches which are more or less quadrangular in form, edged by a lighter streak. On the sides between the blotches and belly-scales there are two rows of dark spots, which coalesce in the tail region with the blotches so as to form half rings; the head has the characteristic form, is markedly triangular, with powerful jaws, and looked at from above it is covered with tuberculate and carinated scales; (see Fig. 6) the only large scales seen are the strongly developed superciliaries which project far over the eye, each of which is traversed by a fine yellow line bifurcating at its median end; looked at from the side the head-scales are all larger and there are two striking yellowish streaks extending from the angles of the eye back to the angle of the mouth. The large rostral scale is marked by a white line on the margins.

The harmless snakes, the Colubers, are much more abundant than the poisonous varieties just mentioned and can easily be distinguished from them even upon a superficial examination of their slender form, the large scales covering the head, the smooth scales covering the body in many species, together with the absence of the maxillary pit. When the mouth is opened two long rows of small teeth are found in the upper jaw attached to the palatal and the maxillary bones. The numerous small curved maxillary teeth on the long maxilla replace the single large fang on the short quadrate bone found in the vipers. Many people are afraid of handling the Colubers, dreading the bite and an extensive lacerated wound. The fact is that the bite of the largest of them, 5 or 6 feet long is quite insignificant. I have myself twice been bitten recently by a large blacksnake and by this large, powerful water-snake; a few trifling punctures and a few drops of blood were the only result, and the wound healed as though the skin had been pricked by a needle. Any one of these snakes will attempt to make his escape when encountered, but most of them will fight when cornered, or when picked up for the first time. The blacksnake particularly deserves his reputation as a fighter; one which I have been keeping in the country in a large vivarium is always ready to fight me every time I enter.

As an example of a fine Coluber here is a corn-snake (*Colapeltis guttatus*) looking much like a blacksnake, 55 inches long, with 27 rows of scales across the back, and on close inspection those towards the middle are found to be faintly keeled while the lateral ones are smooth. The usual coloration of this snake is a reddish-brown color with a row of blotches down the back. In this specimen the color is almost uniformly a dull reddish black. Closely allied to this is the pilot-snake, which is one of our largest serpents, measuring six feet or more.

Here is another beautiful, graceful, harmless snake, one of

the slenderest of our large snakes, known as the coachwhip (*Masticophis flagelliformis*), received from Dr. Goss in Georgia. This specimen is 79½ inches in length. The fore part of the body, as you observe, is jet black above and below, and shades gradually backward into a dull white; the tail is particularly beautiful, as the smooth scales there become broader and margined with a darker streak marking each wart and giving it a tessellated appearance. The eye of this snake is large and handsome, while the pupil is surrounded by a reddish iris which gives it, under the overhanging superciliary, a particularly striking lustrous appearance, not unlike the imitation snakes made in the form of bracelets by the jewelers. I show here the arrangement of the scales of the head, giving the peculiar elongate vertical plate with the large superciliaries and occipitals. Note that although the length of the jaw as measured to the commissure is only 33 mm., the real length is 40 mm., as the angle of the jaw lies well behind the commissure, showing that the capacity to swallow is much greater than would at first sight seem possible.

I shall not pause to dwell on the specific characters of a number of snakes I here show you which are manifestly harmless; among them are the young of the hognose viper (*Heterodon simus*), the exquisite slender little green snake (*Opheodrys aestivus*) from Georgia, and a little *Storeria Dekayi* of a dim or slate color, with small dark spots on the back, only ten inches in length and three-sixteenths of an inch in diameter.

Most important is it that you should learn to recognize and differentiate certain perfectly harmless snakes which through ignorance have acquired a bad reputation. Here, for example, is a full-grown hognosed viper, or spreading, puffing or blowing adder (*Heterodon*) as it is often called, one of our most valuable serpents in the destruction of field-vermin, found over a wide geographical range, and everywhere in ill-repute as deadly poisonous, and yet perfectly harmless and most gentle and easily tamed. When first alarmed this snake flattens himself out until the upper part of his body and his head are spread out like a thin skin and bearing a remarkable resemblance to the hood of a cobra. He then draws in wind and forces it out with a loud hissing sound, presenting on the whole a most threatening and forbidding aspect. Even if you were to pick him up and he bit you, the bite would not amount literally to more than the pricking of "a row of pins."

Of this "viper" there are two species, one blackish and the other with considerable yellow or reddish in the background, respectively *Heterodon niger* and *Heterodon simus*, both of which are easily distinguished by the "hognose," or retrousse nose, formed by the projecting turned-up rostral scale. (See Mr. Becker's drawing, Figs. 7 and 8.)

Another snake with a bad reputation is this one, which came to me from Alabama, labeled "orange-bellied moccasin," "deadly poisonous," which is really only a large water-snake (*Tropidonotus*, or *Natrix*) found abundantly everywhere and not resembling in the least any form of poisonous serpent except in his natural vicious, ugly disposition. He is confused with the true moccasin (*Agkistrodon*) because he is dull in color and found about the water in the same localities, and is rough-backed with prominent carinated scales; but a glance at the head, which is elongate and colubiform, the



FIG. 1

*Ophibolus getulus*, king snake, or chain snake, one of the most beautiful of our harmless snakes, found through the South and as far north as Maryland, invaluable in the destruction of vermin. The markings are black and white or

yellowish. The loreal scale is seen between the anteorbital and the nasal. The absence of a pit and the form of the head show that this is not a poisonous snake.



FIG. 2

*Agkistrodon Contortrix*, Copperhead, a common pit viper of wide distribution, belonging to the same genus as the moccasin. The most marked difference in the sentation



FIG. 3

of the head lies in the presence of the loreal scale, between anteorbital and nasal in the copperhead, and its absence in the moccasin.







FIG. 4.

*Agkistrodon piscivorus*, true moccasin. The head is large and triangular with massive jaws. The plates and scales are large. The pit is well shown on a line joining the nostril with the lower border of the eye. There is no loreal scale



FIG. 5.

between the nasal and the anteorbitals. The markings on the side of the head are characteristic. Those on the body seen in Fig. 4 are often obscure.

*Crotalus confluentus*, "Prairie rattlesnake," from Oklahoma, one of the group of rattlesnakes with square blotches on the back.

Note the absence of large scales on top of the head, with the exception of the projecting superciliaries. The pit is seen below and behind the nostril. The arrangement of the lines on the head is characteristic of the species.



FIG. 6.





FIG. 7

*Heterodon*, puffing adder, hognosed viper. A harmless and valuable but threatening looking snake. The turned-up rostral plate at the end of the snout is the characteristic mark of the genus.



FIG. 8

This snake has the power of flattening out its head and the upper part of the neck until it bears a remarkable resemblance to a cobra.



FIG. 9

*Natrix Sipedon*, water snake, often erroneously called "water moccasin," and confused with the true moccasin (*agkistrodon*), a pugnacious but a harmless animal. The head



FIG. 10

is narrow, oval, and the vertical plate between the eyes is also narrowed in remarkable contrast with the true moccasin (see Fig. 4). There is no pit.





absence of the pit and the side-lines so characteristic of the true moccasin at once serve to differentiate the two. (Figs. 9 & 10.

The *Tropidonotus* is a snake not so useful as our land-snake, as he lives on fishes and frogs, and I am willing to admit the question whether he ought not to be killed.

"Highland moccasin" is another term applied to a harmless snake which on account of the unfortunate name is condemned to be killed wherever he is found.

## ON THE CHEMISTRY, TOXICOLOGY AND THERAPY OF SNAKE POISONING.\*

BY THOMAS R. BROWN, M. D.

In this portion of the country, the subject of the poison of venomous snakes and the treatment of snake-bite is rarely brought to our notice, due of course largely to the extreme rarity of the condition and the paucity of snakes of high degrees of toxicity.

Nevertheless, when one considers that in India alone the lives of more than twenty thousand human beings and sixty thousand cattle are annually sacrificed to the poisonous *Ophidia*, and that in Africa, Australia, Central and South America and the islands of the Indian and Eastern Pacific oceans many deaths occur annually from the same cause, it will be seen that the subject is one of sufficient magnitude to appeal to every one interested in the general subject of medicine in its broader sense.

Indeed, we have but to turn the pages of the journals devoted to bacteriology, chemistry and toxicology for the past ten years to recognize how much work is being done in this direction and how marked are the advances recently made in our knowledge of the subject.

Before going more carefully into the chemical and therapeutical side of the subject, it will be of interest to sketch briefly the morphological and zoological characteristics of the poisonous snakes and to mention the most important representatives and their geographical distribution.

The great family of snakes—the order *Ophidia*, has three divisions, the *O. colubriformia* which are innocent, the *O. colubriformia venenosa* and the *O. viperiformia*, the last two of which are poisonous and compose the *Thanatophidia*—a well merited name when one considers their great destructiveness.

A rapid and easy method of differentiating the innocent from the poisonous snakes is by an examination of their jaws, the harmless snake having two complete rows of small ungrooved teeth, an inner palatine and an outer maxillary, while in the venomous snakes the outer row is represented by one or more large tubular fangs firmly ankylosed to the maxillary bone.

This bone, by its movements, causes the erection or retraction of the fangs.

The maxillary bone is much smaller in the poisonous colubrine than in the innocent snake, while in the viperine snake

I trust that this demonstration with the living forms before you will impress upon you the easily recognized differences between poisonous and non-poisonous forms so that you will feel yourselves not only equipped to decide in case of accident whether the bite of a particular snake is liable to be followed by dangerous symptoms, but that you will constitute yourselves as well defenders of the harmless snakes, which are not only of great economical value but aid as well in the destruction of the poisonous forms.

It is reduced to a mere wedge, giving insertion to a long curved tubular fang. These fangs, when reclined, are covered by a sheath of mucous membrane, in which lie also several reserve fangs in different stages of growth, which are designed to replace the working fang, if it should be shed or lost through accident. The fangs, although described as being perforated, are in reality not so, this effect being produced by a folding of the dense, compact tooth on itself, forming either an open groove as in *Hydrophidae*, a complete canal as in *Cobra* or a still more complete tube as in *Viperidae*.

The poison is secreted by a conglobate racemose gland, almond-sized in the cobra, and opening by a duct into the capsule of mucous membrane, enveloping the base of the fang, the venom thence flowing into the dental canal, the same muscles which close the jaw also compressing the poison-gland and forcing the poison through the duct. At the orifice of the duct, a sphincter arrangement of muscle fibres has been described by Fayrer in the cobra and by Weir Mitchell in the rattlesnake.

With the exception of New Zealand and the Oceanic Islands, venomous snakes are found almost all over the tropical and temperate regions of the world.

Among the more important of the poisonous snakes we have: in North America, *Ancistrodon contortrix* (copperhead), *Ancistrodon piscivorus* (water-moccasin), the many varieties of *Crotalus* (rattlesnake); in South America, *Elaps corallinus* (coral-snake), *Elaps lemniscatus*, *Lachesis mutus* and *rhombata* (bushmaster); in Central America, *Bothrops lanceolatus* (lance-snake); in the West Indies, *Craspedocephalus*; in Europe, *Pelias* or *Vipera berus* (adder), which is found throughout most of Europe, while in Dalmatia, Hungary and Greece we also have *Vipera Redii*, and in southern Europe, *Vipera ammodytes* (sand-viper); in Africa, *Naja haje* (asp), *Naja haemachates*, *Naja noir* and *Cerastes*, while in Australia we have *Hoplocephalus curtus* (tiger-snake), *Pseudechis* (blacksnake) and *Acanthophis* (deaf-adder).

Our knowledge of the *Thanatophidia* of India is very complete, due to the monumental work of Sir Joseph Fayrer, and it is upon the poison of these snakes that much of the best recent work has been done.

The venomous colubrine snakes of India are: of *Elapidae*, *Naja tripudians* (cobra), *Ophisphagus elaps* (hamadryad), *Bungarus ceruleus* (krait), *Bungarus fasciatus* (san kni); of

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Xenurelaps, *X. bungaroides* and the various species of *Collophis*; and *Hydrophidae*, a very numerous and extremely poisonous family of sea-snakes, but, on account of their habitat, not very harmful.

The Indian viperine snakes are represented by: *Daboia Russellii* (chain-viper), *Echis carinata* (kuppur, or phoorsa-snake)—these are true vipers, while the *Crotalidae* or pit-vipers are only feebly represented by *Trimerisuri*, *Peltopelor*, *Halys* and *Hypnale*, which are much less poisonous than their American congeners, *Crotalus*, *Lachesis* and *Craspedocephalus*.

In India in 1898, 21,901 human beings died from the effect of snake-bite, and in this enormous mortality, the snakes stood in point of destructiveness in the following order: Cobra, Krait, *Echis*, *Daboia*. The toxicity of the venom, besides varying according to the species, varies markedly in the same species and variety.

Thus, the bite of the snakes of the tropics is far more dangerous than of the corresponding varieties in Europe. There is also a marked difference according to the time of year, the bite being more dangerous in the warmer season; in fact, the intensity of the venom in the same snake varies from day to day, being more on hotter days, less on cooler days; also the bites of hungry snakes are less severe than those of well-fed ones.

The poison acts most readily upon warm-blooded animals, especially if directed at once into the veins, but it is deadly to cold-blooded animals as well and to the lowest forms of invertebrate life.

Strange to say, a snake cannot poison itself or any of its species, and only slightly any other genus of poisonous snake, but innocent snakes it poisons quickly.

In some cases, especially when the victim is weak, or the poison is injected directly into the veins, death is almost instantaneous, while in other cases, death may not occur for a long while, and this may be due to a secondary infection, due to the destruction of the bactericidal properties of the blood by the venom.

As to the locality of the bite, in the great majority of cases this is on the extremities (in 61 of 65 fatal cases tabulated by Fayrer).

According to Fayrer's statistics obtained from his study of 65 fatal cases in India, 7 died under 1 hour, 8 between 1 and 2 hours after the bite, 9 between 2 and 3 hours, and 13 over 24 hours.

The symptoms of snake-bite are both local and general, these differing in relative intensity, according to the conditions of the case and the variety of snake.

*Ceteris paribus*, the local symptoms are the more marked, the more prolonged the case; while in cases of rapidly fatal termination, they may be practically wanting altogether.

These local symptoms differ somewhat with the variety of the snake, but, speaking generally, consist of a rapidly appearing, inflammatory, local oedema of the affected spot, followed later by more or less ecchymosis and gangrene, with or without pain, and often with the appearance of lymphangitis and local phlegmons. In the *Crotalidae*, where the local lesion is especially severe, besides the oedema we have extensive gan-

grene of the affected portion of the body; according to Fayrer, *Naja* (a colubrine) kills without destroying the blood's coagulability, while *Daboia* (a viperine) produces complete permanent fluidity.

The constitutional symptoms are to be ascribed to a poisoning of the cerebral and spinal centres, especially those of the medulla, inducing general paralysis, especially of respiration, paresthesias, and precordial pain.

Besides these we often have a marked tendency to hemorrhage from the various organs of the body (hematuria, hematemesis, etc.), diarrhea, vomiting, disturbances of vision and amaurosis, headache, dizziness and violent dyspnoea.

In cobra poisoning we have an especially rapid destruction of the respiratory functions, but the pupil of the eye is not affected, while in *daboia* poisoning, we have wide pupillary dilatation; there is also a greater tendency to convulsions in cobra poisoning. The cause of death may be (1), general paralysis, especially paralysis of respiration, (2), tetanic arrest of cardiac action, probably due to the action of the venom upon the cardiac ganglia, (3), a combination of these causes, (4), secondary infections of various characters, due to the destruction by the venom of the bactericidal power of the serum.

Even in the patients that recover, local paralyses in the most diverse parts of the body may persist for a long time, together with various local manifestations in the portion of the body bitten, paresthesias of various kinds, pemphigoid eruptions and pain.

Of late years, a great deal of investigation has been carried on upon the action of snake-poison, by means of animal experimentation.

Ewing has shown that the normal germicidal power of the serum is entirely lost after poisoning with *Crotalus* venom, and the same results have been obtained after poisoning by *Pseudechis* in Australia.

Many observers have shown the marked hemolytic action of the majority of snake-venoms, while Halford and Martin have called attention to the marked increase of leucocytes in the blood of animals that have recovered from snake-bite.

Brunton and Fayrer concluded from their experiments on certain of the mammals and on frogs, that cobra poison, besides paralyzing the reflex action of the cord acts upon the nerve-endings in the muscle as curare does, and Ragotzi, who has confirmed these observations, thinks that "failure of respiration is mainly brought about by this paralysis of the nerve-endings in muscle, and that the direct action of cobra-poison on the central nervous system is altogether subsidiary."

Many other interesting points regarding the physiological action of venoms have been observed, and in many cases slightly different effects have been noted, according to the species of snake from which the venom was obtained, a result not at all unexpected when we remember that there are quite marked differences in the symptoms of human beings poisoned by snakes.

As we shall see later on, however, Calmette regards the primary action of all snake-venom as the same in kind, although differing in degree, ascribing the symptoms at variance in the different cases to the presence of various albuminoid substances in the venoms, which have but little to



do with the real cause of death. Following the line of work instigated by Roux and Vaillard, in the case of tetanotoxine, Calmette and Martin, working separately, have worked out the toxic value of some of the venoms, i. e., the number of grammes of an animal (rabbit), which is killed by 1 gramme of poison introduced subcutaneously.

Calmette's results were—

Cobra, . . . . .	4,000,000
Hoplocephalus curtus, . . . .	3,450,000
Pseudechis, . . . . .	800,000
Pelias berus, . . . . .	250,000

while Martin placed the toxic power of the Australian venoms somewhat higher, thus:

Hoplocephalus curtus, . . . .	4,000,000
Pseudechis, . . . . .	2,000,000

The diagnosis of snake bite is, of course, easily made from the history of the case and the symptoms, and by an examination of the bitten spot.

#### PROGNOSIS.

As to the prognosis, this varies markedly with the country, the climate, and the species of snake. If one of the Indian snakes, Cobra, Hamadryad, Bungaris or Daboia, has inoculated its full charge of venom into its victim, the result, according to Sir Joseph Fayrer, is invariably fatal.

In America, Weir Mitchell gives a series with a mortality of 25 per cent., and another with one of 12 per cent., while Ellzey gives 15 per cent. as the usual proportion of deaths.

In Australia, it is given as about 7 per cent.

The much lower mortality in the last two countries probably depends partly upon the greater intelligence of their peoples, and their recognition of the absolute necessity for prompt treatment.

#### THE CHEMISTRY OF SNAKE-VENOM.

The chemistry of snake-venom should be of especial interest to Americans, because the greatest advances in our knowledge of the subject have come from the work of American investigators, especially Weir Mitchell and Reichert.

Fontana in 1781, and Prince Lucien Bonaparte in 1843, made analyses of viper-poison, and concluded that its toxicity was due to an active principle, achidine or viperine.

Busk, from the analogy between the poison-gland of the snake and the parotid, suggested that the poison might be in some way related to ptyaline.

Weir Mitchell in 1860, found in the poison of *Crotalus*, (rattlesnake), two albuminoid substances, one coagulated by boiling and comparatively innocuous, the other not coagulated by boiling and poisonous, and he called attention to the "singular likeness between the symptoms of rattlesnake poisoning and those of certain maladies, such as yellow fever," an analogy already noted by S. L. Mitchell, Majendie and Gaspard, who also called attention to its resemblance to poisoning by putrefying substances.

Gautier, of Paris, ascribed the poisonous properties to a ptomaine, but this has been disproved by Mitchell, Reichert and Gibbs.

Fayrer and Brunton in 1873, showed that cobra-poison

remained active after coagulation by boiling. The work, however, which has done most to clear up the chemistry of snake-venom is that of Mitchell and Reichert, the preliminary report appearing in 1886, while the full details of the work appeared later in the Smithsonian Institute Reports.

Their experiments were carried on upon the poisons of the copperhead, rattlesnake, water-moccasin and cobra.

The poison is a slightly turbid yellowish fluid, more or less viscous, always acid and having a specific gravity of between 1.050 and 1.065. Whether in the liquid or dry state, venom is soluble in water with a slight turbidity.

Venoms usually contain 25 to 50 per cent. of solids, but may contain as little as 12 per cent., or as much as 67 per cent., as noted by Martin in some of the Australian snakes.

Venoms dry rapidly at 16° to 20° C. in a desiccator, and the dried residue resembles markedly dried egg-albumin in its physical properties.

This dried venom if kept from moisture apparently keeps indefinitely, Weir Mitchell having preserved some *Crotalus* venom without apparent diminution of toxicity for 22 years.

In glycerine, also, venom seems to keep indefinitely.

The watery solutions of all the venoms studied, with the single exception of *Crotalus adamanteus*, can be subjected to the temperature of boiling water without the complete destruction of their poisonous properties. In the exception mentioned—the diamond-backed rattlesnake—the toxicity is completely destroyed by a temperature below 80° C.

The work of these two investigators showed that venom consists of at least two, and probably three, proteid-like bodies, two soluble in distilled water, and one not.

Of the two that are soluble, one does not coagulate at 100° C., and this may be obtained by boiling venom which throws down or destroys all the other proteids, and then either dialyzing or filtering.

The various reactions of this body—its positive reaction with the xantho-proteid, Adamkiewicz's and Millon's reagents, the fact that it formed no precipitate with carbon dioxide gas, ferric chloride, copper sulphate, and glacial acetic acid, and that it did form a precipitate with mercuric chloride, absolute alcohol, and potassium ferrocyanide in the presence of weak acetic acid—led them to suppose that it was a peptone and to it they gave the name of venom-peptone.

Some of its reactions were atypical, however; as, its forming a precipitate with dilute acetic acid but redissolving in excess of the reagent, its precipitation by sodium chloride, which precipitate was soluble in an excess of glacial acetic acid; these and other considerations led Wolfenden to call attention to it again and to point out that it is probably, more truly speaking, an albumose. The precipitate formed by adding water to venom was found to have the properties of a globulin, especially of paraglobulin, and was called venom-globulin; while the third proteid present, their venom-albumin, had the properties of an albumin and was considered harmless by Mitchell and Reichert. According to their experiments, the globulin acts more on the respiration, circulation and blood, tending to destroy the red blood-corpuscles, prevent coagulation, produce ecchymosis, lower blood-pressure and paralyze respiration, while the peptone (or albumose) acts more on the

tissues tending to cause oedema, putrefaction and sloughing. While most venoms contain (a) a proteid coagulable by heat and (b) a proteid or proteids not thrown out of solution by this means, it is nevertheless extremely difficult to assign exact positions to these bodies, because of the somewhat arbitrary and rather artificial means of differentiation at present in vogue, and because of the fact that many of the constituents of various venoms give atypical reactions, rendering it impossible to definitely assign them to any especial group, although the great majority of their properties may harmonize completely with those of a special class, the peptones, the proto-albumoses, etc., for example.

Recent work seems to show that cobra-poison and pseudochis-poison contain proto-albumose, while crotalus-venom seems to contain a body more closely related to the deutero-albumoses.

The amount of proteid coagulated by heat differs considerably in different species; thus, it is 24.6 per cent. in *Crotalus*, 7.8 per cent. in *Ancistrodon*, and only 1.75 per cent. in *Cobra*.

The whole question of the exact position of the various constituents of venom in the proteid family must be left in *statu quo* until a more definite and scientific means of differentiation of the various members is possible.

Until then, by some observers, the venoms will be regarded as made up of globulins and peptones, by others as globulins and albumoses, and by still others as albumoses alone.

A few words may be of interest as to the effect of various substances upon snake-venom, especially as it is because of these reactions that many of the therapeutic measures applied to snake-bite have been suggested.

Venoms are rendered inert by those chemical agents that destroy proteids or precipitate them in insoluble form, such as gold chloride, potassium permanganate, nitric acid and nitrate of silver; the same effect is noted with the hypochlorites, and also with more prolonged action of carbolic acid and the caustic alkalis.

Although Mitchell found that the venom of *Crotalus* was destroyed by gastric digestion, the venoms of *Cobra*, *Pseudechis* and *Pelias berus* have been shown to be unaffected thereby; while all venoms are rapidly destroyed by pancreatic digestion.

Freezing does not affect the various kinds of venoms, but they are all profoundly modified by being heated at a temperature between 75° and 80° C. Of late much attention has been called to the resemblance between the formation of snake-venom, and the production of the poisons by the diphtheria bacillus, anthrax bacillus and tubercle bacillus on the one hand, and the products of gastric and pancreatic digestion on the other.

In all these processes, various albumoses are formed, varying markedly in the degree of their toxicity, but all more or less poisonous if injected subcutaneously, while in some the process is carried still farther with the production of peptones.

As stated before, in the case of snake-poison the process of albumin-hydration probably stops short of this stage.

Another interesting point is that in some of these cases, notably gastric and pancreatic digestion, and digestion by the diphtheria bacillus, this conversion of the albumins into albumoses is brought about through the agency of a ferment

or enzyme; while recently it has been suggested that in the formation of snake-venom, an enzyme may possibly take part.

#### TREATMENT OF SNAKE-BITE.

It is, however, regarding the treatment of snake-bite that most interest has centered during the past few years.

One has but to glance over the myriad medicaments used in this condition, drawn from the animal, vegetable and mineral kingdoms, to recognize how utterly unscientific and irrational has been the treatment of the great majority of cases, while many of the so-called remedies come directly from the realms of witchcraft and voodooism.

And yet in no condition more markedly than in this does the old adage "Bis dat, qui cito dat" hold good.

The prime object is to prevent the absorption of the poison, and if this can be done rapidly and efficaciously, we may get cures in cases in which a few minutes' delay or the wasting of time in useless procedures would inevitably result in death.

As to the best local treatment to be carried out, this varies somewhat according to the authority quoted, but the main principles are the same in all.

In the first place, a tight ligature should be applied above the bitten spot, if this is on the extremities, as we have seen is so in about 95 per cent. of cases.

As much of the poison as possible should then be removed, by scarification of the wound, excision in some cases, amputation, perhaps, if the bite is on a finger or toe and the species of snake a very dangerous one, tight bandaging from above and below toward the wound, cauterization of the bitten area, cupping or sucking the wound, although this last procedure is vigorously opposed by Fayer and others.

About the wound should then be injected some one of the substances which experiments have shown to be rapidly destructive to the venom, usually by oxidizing it into harmless or less harmful substances.

For this purpose, potassium permanganate in solutions of from 1 per cent. to 5 per cent. as recommended by Blyth, Lacerda and Aron, and calcium hypochlorite or gold chloride as recommended by Calmette before he had developed his present method of treatment, are probably the best, although if these are not at hand, the caustic alkalis, bromine or chlorine water, carbolic, tartaric or chromic acids, tincture of iodine or even dilute solutions of mercuric chloride may be used.

Obviously all of the above-mentioned remedies are useless when the poison has once reached the general circulation, as none of these substances owe their efficacy to anything but their ability to destroy or oxidize proteids, or to form with them insoluble compounds, and would thus act equally destructively on the tissues of the body if injected into the system.

If the venom has reached the general circulation, besides hastening its elimination by washing out the stomach, and keeping the bowels and bladder well emptied (for it has been shown that the poison is, at least partially, excreted by the kidney), our energies should be devoted to counteracting as much as possible the constitutional effects of the poison, by the use of appropriate means.

Probably lives have been saved by these means, especially



after bites by the less venomous species of snakes, but according to Fayer, all treatment is practically useless in those cases in which a member of the Indian *Thanatophidia* has injected its full quantity of poison into its victim, and local treatment has not been immediate. Among the remedies which have been most used to attempt to counteract the poison's constitutional effects, may be mentioned alcohol, ammonia and strychnia.

From time immemorial, alcohol has been used in this condition for its stimulating effect, while it has only been comparatively recently that ammonia has been given in any other way than by the mouth.

Due to Halford's experiments, large doses—as much as 1 drachm of the liquor ammoniae fortior—were given hypodermically, but later work has shown the utter uselessness of this drug as an antidote.

The same is largely true of strychnia, recommended first by Pringle in 1868, and more recently, in 1889, strongly advocated by Mueller, who regarded it as a true antidote if given in such large doses as to cause constitutional effects; three years later, however, indisputable figures were brought forward to show that under this treatment the mortality had not been decreased in the slightest degree.

Although useless as antidotes, both these remedies and to a less extent alcohol are probably useful in mild cases in lessening the nervous and cardiac depression after snake-bites.

Because of the marked effect of snake-venom upon the respiratory apparatus, artificial respiration has been tried in a few cases, but although the life of the man or animal is prolonged by this means, no case has been reported in which life has been saved.

Encouraged by the rapid development of the subject of serum-therapy, and by the successful results obtained in many cases, notably diphtheria and tetanus in combating by sera the effects of the toxins of bacterial growth, certain investigators, notably Calmette, at the Pasteur Institute in France, and Fraser, in Great Britain, have turned their attention to the preparation and properties of antivenomous serum, and the possibility of making use of it as a curative agent.

In 1887, however, Sewall, in the United States, first showed that a certain degree of tolerance to rattlesnake poison could be obtained by frequently feeding animals on small doses of the venom.

The results obtained by Fraser and Calmette have been quite markedly different, while their views regarding the mode of action of the antivenomous serum are almost diametrically opposed to each other, Fraser believing in the specificity of the various venoms and sera, i. e., from a serum which might immunize against one species of snake, much less good results could be expected in the case of poisoning by snakes of other species; while Calmette thinks that the active principle in the poisons of all snakes, and even of poisonous lizards and scorpions is the same, i. e., a serum which would immunize against one variety of very poisonous snake would immunize equally well against all other varieties.

All recent observers are agreed that an animal or person can be vaccinated against what would otherwise prove a fatal dose by the subcutaneous introduction of small, repeated doses of the poison.

But the reasons for this cause discussion—Fraser and Phisalix believing that the protection or immunity is chiefly due to the accumulation in the blood of an antidotal substance, which originates, at least in part, from the venom, and is normally one of the constituents of the poison itself; while Calmette, in direct opposition to this, believes that the antidotal substances are formed in the blood of the vaccinated animal itself by a certain reactive process of the organism.

Fraser, in Great Britain, and Cunningham, in India, found that the antidotal results obtained by using the serum of vaccinated and immunized animals were only of a high degree in the cases of injection of the poison of the *same* species of snake; the latter, among his other conclusions, stating that "blood-serum of vaccinated animals is efficacious as an antivenom, but only against the poison which comes from the same species of snake."

Kanthack, in this connection states that, although most snake-poisons belong to the same physiological group, and yield to the same antidote, nevertheless Calmette's serum prepared against Cobra-venom, has no effect upon Daboia-venom.

According to Fraser's experiments, it would take 300 cc. of the strongest rabbit-serum that he could produce to save the life of an average-sized man who had been bitten by one of the most venomous variety of snakes—an amount so great as to practically destroy the possibility of its practical application. Fraser, also found that the bile of poisonous snakes, and to a much less extent the bile of innocent snakes, of oxen and of guinea-pigs possessed antidotal properties, but here again the bile was much more effective against the poison of that variety of snake from which the bile was obtained; he also states that the serum of venomous serpents likewise possesses some antidotal properties, but Phisalix and Bertrand have described this as a process of vaccination, unless the blood-serum be heated to 60° C., when a true antidote is formed.

This is of especial interest because both snake-blood and snake-bile are very important remedies in the armamentarium of the native Hindoo snake-charmer and doctor, and too many well authenticated stories exist, showing immunity and cure to make it at all doubtful that these persons possess methods of treatment which are doubtless of value. The rationale of these experiments of Fraser's in regard to the antitoxic action of the bile is, of course, directly derived from the oft-repeated observation that the venom, unchanged in the stomach, is rendered rapidly inert after entering the duodenum, Fraser therefore regarding it as likely that the bile played some important part in this destruction or neutralization.

As bile is itself poisonous, Fraser isolated from the bile a non-toxic substance which had marked anti-venomous properties, and suggested that this might possibly be used for curative purposes outside the laboratory.

He also found that by feeding animals upon snake-poison, an immunity could be produced which would last 4 to 5 days; as however, at least 2 hours are required to establish this immunity after the feeding, the result of this experiment can be of no practical value.

Calmette, at the Pasteur Institute at Lille, France, has been carrying on experiments upon snake-venom exactly analogous



to those upon the toxins of tetanus and diphtheria, at first using small animals, but of late making use of larger animals, especially horses, in the preparation of his antivenomous serum. In July, 1896, his results had been attended with such success that he presented them to the Royal College of Physicians and Surgeons in London. These experiments were designed to show both the preventive and curative powers of his serum, and were as follows:—

(1) The lethal dose of cobra-venom being found to be 1 milligramme of dried substance (subcutaneously administered), which will kill a rabbit in 12 hours, or 2 milligrammes will kill in 16 to 17 minutes, 3 c. cm. of the protective serum was injected, and 6 hours later, 2 mg. of the dried venom; no symptoms occurred in these immunized rabbits, while control animals died in 16 and 17 minutes respectively.

(2) A second series was given 5 mg. of the dried venom subcutaneously, and one hour later 3 c. cm. of the antivenomous serum; all remained well.

(3) In a third series, 3 c. cm. of the antitoxine were injected one-half, one and one and a half hours after the injection of a fatal dose of the poison, and only in the last case (i. e., those injected one and a half hours afterwards) did the rabbits die.

All the animals that recovered in these experiments were perfectly well 8 days later.

The 1st experiment was designed to show the preventive, the 2d and 3d to show the curative powers of the serum.

In concluding another article on the same subject, Calmette says:—"Animals may be immunized against the venom of serpents either by means of repeated injections of doses, at first feeble, and becoming progressively stronger, or by means of successive injections of venom mixed with certain chemical substances, among which I may especially mention the chloride of gold and the hypochlorites of lime and soda; the serum of animals thus treated is at the same time preventive, antitoxic and therapeutic, exactly as is that of animals immunized against diphtheria and tetanus."

Calmette studied the venom of the following reptiles: *Naja tripudians*, *Crotalus durissus*, *Bothrops lanceolatus*, *Naja haje*, *Cerastes*, *Bungarus fasciatus*, *Pseudechis*, *Hoplocephalus curtus*, *H. variegatus*, *Acanthophis antarcticus*, *Trimeresurus viridis* and *Trigonocephalus contortrix*.

Although all these venoms have their well marked toxic peculiarities and produce their various local phenomena, nevertheless animals immunized by vaccination against very large doses of any of these venoms, resist likewise inoculations of very powerful doses of the venom of any one of the other serpents mentioned, according to Calmette.

This belief in the non-specificity of the toxins and antitoxins of snake-venom is shared by other investigators on the same subject, as Wehrmann.

In this connection it is interesting to note some of the discoveries in the field of serum-therapy that have a suggestive bearing upon this point.

Marmorek has shown that animals immunized against anthrax or tetanus furnish a serum antitoxic to snake-venom; also that dogs immunized to a high degree against rabies are capable of great resistance to snake-poison; while Calmette and others have shown that rabbits vaccinated against snake-

venom, become resistant to poisoning by abrine, while those vaccinated against abrine may in turn acquire a certain degree of immunity against snake-venom, diphtheria, ricine or even sometimes against anthrax, and animals vaccinated against erysipelas or rabies may possess a serum that may even be preventive against snake-venom.

Calmette is violently opposed to the idea that there is a chemical neutralization of the toxins by the antitoxine, he regarding the immunity as due to a certain "insensibilization" of the cells in respect to the venom, which is conferred upon them for a short time by the antitoxine.

In support of this, he showed by experiment that if a lethal dose of venom and a corresponding dose of anti-venomous serum be mixed in a test-tube and injected into an animal, there are no injurious effects; while if the mixture, after standing for a sufficient length of time to bring about any chemical reaction if it should take place, be heated to 70° C. (at which temperature the antitoxic serum loses its efficacy) and then injected, death occurs as if the animal had received no antidote whatever.

Recent experiments suggest that some, at least, of the immunity after antivenomous serum has been injected, may be due to increased powers of phagocytosis towards the toxin on the part of the leucocytes.

Whatever may be our views as to the specificity or non-specificity of toxins and antitoxine, nevertheless the practical results obtained from the use of the serum give promise of great success.

For the past two and a half years, the Pasteur Institute at Lille, has been sending out serum of a high immunizing power to various parts of the world where snake-poisoning is frequent, and already has received reports showing favorable results in persons that have been bitten by the following varieties of venomous snakes: (1) *Naja tripudians* (cobra) of Indo-China, (2) *Bungarus ceruleus* (krait) of India, (3) *Naja haje* (asp) of Egypt, (4) *Naja noir* of West Africa and (5) *Bothrops lanceolatus* of Central America, although Martin has so far been unable to get such good results in those bitten by the Australian snakes.

It may be of interest to report one of these cases more in detail.

A boy working in the laboratory at Lille, while carelessly opening a box of newly arrived snakes, was bitten on the hand; almost immediately symptoms of violent intoxication set in, and in an hour, besides the swelling and oedema, there was insensibility of the hand and forearm, great pain in the upper arm, neck and axilla, and nausea.

12 c. cm. of the serum were injected and immediately the symptoms commenced to subside, and by the next day the boy was practically well. A woman who happened to be bitten by the same lot of snakes died in 2 hours, untreated.

Incidental to the more practical side of his work, Calmette has made a number of other interesting observations: For instance; vaccinated rabbits remain immune for a considerable length of time, losing their immunity the more rapidly, the more quickly they have become immunized; the female rabbit is able to transmit her immunity, provided the gestation takes place at the height of the immunizing period, the young

retaining this immunity for about 2 months; on the other hand the immunized male rabbit is unable to transmit his immunity to his offspring.

Even from the short account that I have given, it will be seen that decided advances have been made during the past few years, in our knowledge of the nature of snake-poison, while the number of favorable reports of the use of the antivenomous serum makes it probable that a real antidote to snake-poison has at last been found.

In an article as brief as this, it is impossible to more than touch lightly upon the many interesting points in connection with snake-venom and snake-bite, but if any one cares to delve more deeply into the subject, I would refer him to the comprehensive articles of Mitchell, Fayrer, Lauder-Brunton, Calmette, Fraser, Kanthack, Martin, Cunningham and Wall, in whose pages he will find much that will prove of interest to the student of natural history, of toxicology, of chemistry, and of medicine and therapeutics.

## THE MENSURATION AND CAPACITY OF THE FEMALE BLADDER.

OBSERVATIONS ON THE FEMALE BLADDER DILATED BY ATMOSPHERIC PRESSURE IN THE KNEE-BREAST POSTURE.\*

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[The investigations here reported were undertaken by the writers upon the suggestion and with the constant aid and direction of Dr. Howard A. Kelly, of the Johns Hopkins Hospital, to whom they take pleasure in acknowledging their indebtedness.]

The interest attaching to the work is both practical and scientific, for it concerns the gynecologist even more than the anatomist.

How little is really known about the bladder is found upon a cursory reading of the surgical and anatomical text-books containing their meager and contradictory statements. The measurements and capacity of the female bladder, given in the text-books, have been determined by *post-mortem* examination, by distention to discomfort by urine (or other fluids), and by other inexact methods, which have given imperfect and often contradictory results.

The methods employed by the writers in their investigation differ from those heretofore employed in essential and important respects:—1st, all measurements have been made on living women, in most cases with the bladder either perfectly healthy, or so slightly changed from the normal as not to affect the accuracy of the results; 2d, all examinations have been made with the women in the knee-breast posture, with the rectum, vagina and bladder all (with a few exceptions), dilated with air, according to the method so well known from the writings of Kelly. With all cases thus placed under similar conditions for the examination, the chief sources of avoidable error were removed, and relative measurements could be made and certain averages and standards found. It was, of course, impracticable to estimate the variations of intra-abdominal pressure in different cases or to fix upon a standard of this force, but repeated examinations of the capacity of the bladder in the same case showed that this force was nearly uniform. Although this force may be assumed to vary in different cases and thus to influence the capacity of the bladder when it is opened to the entrance of

the outside air, still we believe that this variation is far less important than the variation due to individual tolerance or irritability to fluid distention, the method previously most generally employed in determining the capacity of the bladder. It was found, moreover, that by this method of air dilatation, no discomfort\* was felt by the woman, and consequently no resistance, either voluntary or involuntary, was offered by her, thus adding to the uniformity of the conditions of observation. On the contrary, it was found that distention by fluid to discomfort was subject to the peculiar and varying irritability or tolerance of the subject, and thus gave no uniform basis of comparison.

The work was undertaken primarily to afford to the gynecologist some additional information on the size, shape, position, internal measurements, and capacity of the bladder, and incidentally to furnish the anatomist with some of the same data.

Had the study been made primarily from the anatomical viewpoint, it might have been better to have made the observations on the bladder alone distended, without the distention also of the vagina and rectum. But we have found that while the dilated vagina and rectum have a certain influence on the shape and position of the dilated bladder, they influence only slightly its air capacity.†

The chief points investigated were, 1st, the average atmospheric distention capacity of the female bladder, and 2d, its actual internal measurements, from the internal urethral orifice to certain chosen points on its walls.

For the purpose of the first study, the woman was put in the knee-breast posture and the three pelvic cavities were each allowed to dilate with air. A closely fitting catheter was then introduced into the bladder, attached at its

\*Abbreviated report of the paper read before the Johns Hopkins Medical Society, December 4, 1899. The full report will appear in the *Journal of the American Medical Association*, December 16, 1899.

\*The patients never complained of discomforts from the distended bladder while in the knee-breast posture. After rotation to the dorsal position, however, they usually felt some slight discomfort, if they were not under anæsthesia, and were instructed, before being rotated, to refrain from any expulsive effort.

†This last statement needs confirmation, as our observations on this point were few.

external end to a long, soft rubber tube. The rubber tube was closed by a clamp and the woman was then rotated carefully by assistants from the knee-breast into the dorsal position. The rubber tube was then introduced into a deep vessel of water and from below upward into an inverted glass graduated cylinder completely filled with water, and was held pointing upward in this position by an assistant. The clamp on the tube was then released, and the entire air content of the bladder was expressed by the ordinary gynecological bimanual method, with one hand exerting pressure on the bladder externally from the abdominal wall and with the other hand pressing at the same time upon the bladder from within the vagina or rectum.

The air thus expressed was collected in the glass cylinder, displacing from above downward an equal amount of water, and the amount was read off on the graduated cylinder, thus determining the exact air capacity of the bladder.

To test whether all the air was thus removed from the bladder, a special instrument was devised, consisting of a double-barreled catheter (Figs. I and II), by which the bladder, after bimanual expression, was flushed with boric solution, and any air remaining in it was forced out and collected for measurement. It was thus found that bimanual expression had been effectual and complete, and practically all the air in the bladder had been removed.

In the 25 women examined the average bladder capacity by atmospheric dilatation was found to be 303 cc., individual cases ranging from a minimum of 160 cc. to a maximum of 545 cc.

Measurement was also made in 22 cases of the fluid content of the bladder, boric solution being used for this purpose. On anesthetized cases the solution was introduced through the double-barreled catheter until it overflowed through the upper barrel, on the cases without anesthesia, until discomfort was caused to the woman. The average fluid capacity was thus found to be 429.7 cc., varying in individual cases from a minimum of 210 cc. to a maximum of 840 cc. The fluid capacity of the bladder was thus found to be more than one-third greater than the air capacity, a difference that would be expected, because of the elasticity of the bladder-walls under the increased pressure of fluid.

With reference to the influence of anesthesia on the capacity, the following table has been arranged:

	Atmospheric Capacity.	Fluid Capacity.
With anesthesia, 306.7 cc. { (average ) { 17 cases.) }		449.0 cc. { (average ) { 15 cases.) }
Without " 295.0 cc. { (average ) { 8 cases ) }		387.1 cc. { (average ) { 7 cases.) }
303.0 cc. { (average ) { 25 cases.) }		429.7 cc. { (average ) { 22 cases.) }

From these figures it is seen, as might be expected, that the average capacity of the bladder for both air and fluid is somewhat greater with than without anesthesia, explained, doubtless, by the relaxation of the bladder-walls during anesthesia. The above figures tend also to show that this difference is greater with fluid than with atmospheric distention, due to the more varying irritability of the bladder, without anesthesia, to fluid distention.

The influence of child-bearing on the capacity of the bladder is shown in the following table:

	Atmospheric Capacity.	Fluid Capacity.
Nulliparous, 318.8 cc. (average 13 cases.)		464.5 cc. (average 11 cases.)
Parous, 291.2 cc. (average 12 cases.)		395.0 cc. (average 11 cases.)

The explanation of these figures, showing the greater capacity of the bladder of nulliparæ, is doubtful, and it may be that it is purely accidental, due to the limited number of cases observed. We would suggest, however, that it may be due to the greater elasticity of the bladder of the nullipara, influenced both by her younger average age and by the fact that her bladder and the surrounding tissues have not suffered injury and undergone sclerotic changes as the result of the pressure of the gravid uterus. The influence of age is shown in the fact that the average age of the women who had borne children was 36 years, and of the nulliparous women only 26 years.

The second chief object of this study was to gather some statistics on the internal mensuration of the bladder under atmospheric dilatation in the knee-breast posture. The value of such measurements to the gynecologist is apparent, but they have not before been accurately ascertained.

The distance of certain points from the internal urethral orifice was measured. The points chosen were:

(1) The *vertex*, or summit, the most prominent and distant point in the concavity of the upward and anterior bulging of the ventral wall, placed usually well above the reflection of the peritoneum and the departure of the urachus; (2) the most prominent and distant point in the upward and dorsal bulging of the *posterior wall*. This point is found a few centimeters above the peritoneal reflexion, and is usually opposite the end of the cystoscope when it is held in the axis of the patient's body. Quite frequently, however, the cystoscope must be directed more posteriorly to bring this point into view; (3) the point of greatest outward bulging in the *left lateral wall*; and (4) the point of greatest outward bulging in the *right lateral wall*.

These four points are not scientifically fixed points, but in actual work are found to be sufficiently clearly indicated for practical purposes of identification and description (Fig. III).

The average measurements obtained for these four points were, to

Vertex.....	7.14 cm.	Left lateral wall..	6.70 cm.
Posterior wall.....	5.77 cm.	Right lateral wall.	5.92 cm.

Taking the measurements separately for nulliparous and for parous women, the averages are found to be:

	Vertex.	Posterior wall.	Left lateral wall.	Right lateral wall.
Nulliparous (average, 13 cases)	7.43 cm.	5.75 cm.	7.03 cm.	6.12 cm.
Parous (average, 12 cases) ...	6.83 cm.	5.79 cm.	6.35 cm.	5.72 cm.

The greater average internal dimensions of the bladder of nulliparæ, here shown, correspond to the greater capacity for air and fluid, as already pointed out, and may be explained in the same way.

The asymmetry of the dilated bladder shown by the unequal lateral measurements is of interest. In sixteen cases the left lateral measurement is greater than the right, the reverse is true in six cases, and in three the left and right internal lateral





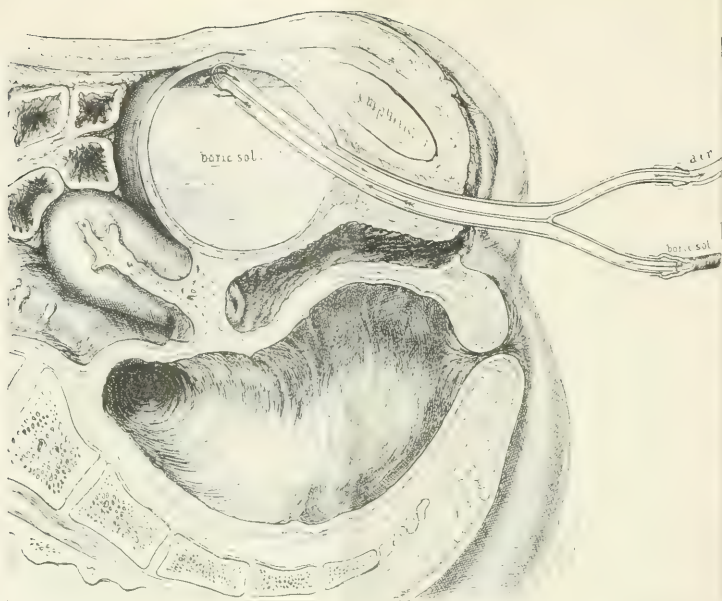


FIG. II

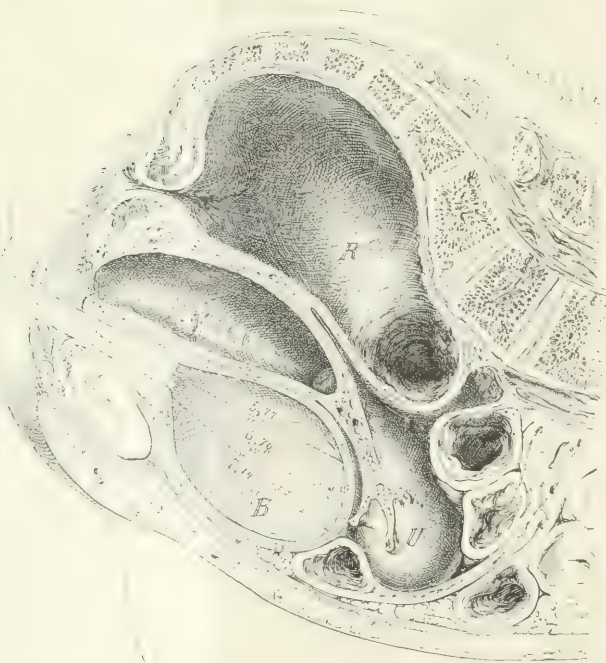
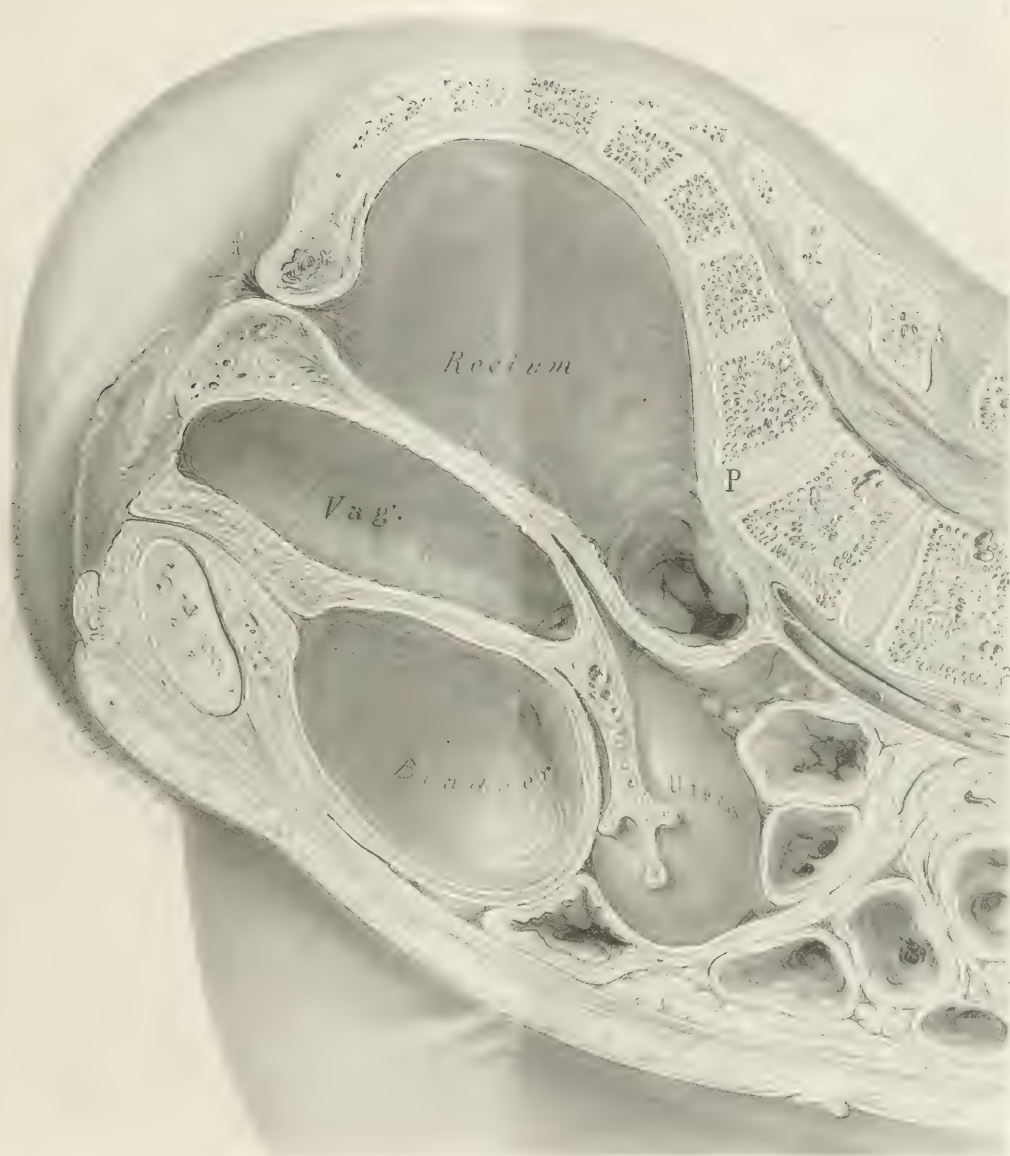


FIG. III







measurements are equal. The occasional asymmetrical position of the bladder has been noted by anatomists, but never before has this asymmetry been recorded in so large a proportion of cases. This tendency of the bladder to be placed more to the left than to the right, at least when the patient is in the knee-breast posture with the three pelvic cavities dilated with air, may be explained by the fact that the rectum in women is found more commonly on the right than the left in the pelvis, and thus the distended rectum tends to displace the bladder toward the left. Our observations on the position of the rectum in women are directly opposed to the usual statements of the text-books of anatomy. Mr. Max Brödel,\* artist to the gynecological department of the Johns Hopkins Hospital, whose observations on the anatomy of the organs of the pelvic cavity have been exact and extensive, informs us that his own experience confirms our observation on this point.

Another factor producing some slight asymmetry of the dilated bladder is the fact that the uterus† is usually placed somewhat to the left of the median line and encroaches upon the left upper posterior quadrant of the bladder, as is well shown in Fig. IV. The influence of this factor is to lower the point of greatest outward bulging of the left lateral wall, point (3), so that it is found to be at a lower level than point (4) on the right lateral wall.

It was found that the same patient examined repeatedly by the same method gave, as a rule, nearly uniform measurements, the variations being slight.

All cases were free from any constricting clothing at the time of the examination, and the rectum had been emptied by cathartic or enema before the examination.

With the patient in the knee-breast posture, and the rectum, vagina and bladder all dilated by atmospheric pressure, it was found that the true pelvis was always completely occupied by these three organs and that the bladder and the uterus tended to rise upward and forward. In multiparæ the uterus was found to be displaced so far upward and forward that its fundus could be felt within a few centimeters of the umbilicus (Fig. IV).

The ballooning of the rectum and vagina before the bladder was allowed to fill with air, was found to be of great importance to the ease of the examination of the ureteral ori-

\*To Messrs. Brödel and Becker, of the Johns Hopkins Hospital, we wish to express our indebtedness for their beautiful drawings from which Figs. II, III and IV have been made.

† This observation is also opposed to the statements of some text-books of anatomy, and is confirmed by Mr. Brödel.

fices, in the fact that the dilated vagina and rectum press from behind upon the base of the bladder, thus bringing the trigonum and ureteral orifices forward and into easy view of the speculum. *Neglect of this point and failure to first allow the rectum and vagina to dilate are accountable in large measure for the difficulty found by many gynecologists in catheterizing the ureters.*

The ureteral orifices were seen on or were indicated by a slight elevation of the mucous membrane, the *mons ureteris* of Kelly, but in some cases in young nulliparous women the ureteral opening was indicated by a small round black point which was never observed in older women who had borne children.

The bladder as a whole, when dilated with air and observed during operation within the pelvic cavity (from abdominal section) was found to be ellipsoidal in form, flattened somewhat in its antero-posterior diameter, and increased transversely. The transverse diameter was always the greatest measurement.

A mathematical calculation of the cubic content of an ellipsoidal viscus of the dimensions of the bladder corresponds closely with the actual air capacity obtained by expression.

The average length of the urethra in seventeen cases was 3.3 cm., the shortest urethra measuring 2.7 cm., and the longest 4.2 cm.

It is hoped by the writers that the measurements and observations above recorded, though limited to twenty-five cases, may prove of interest and service especially to the gynecologist, by affording a certain amount of carefully ascertained facts about the relative measurements and topography of the female bladder under air dilatation in the knee-breast posture.

#### DESCRIPTION OF FIGS. I, II, III, IV.

FIG. I—Represents the double-barreled catheter and attachments, used for determining the residual air in the bladder, after bimanual expression.

FIG. II—Median section, dorsal position, showing the double-barreled catheter in position in the bladder, boric solution entering through the lower chamber and forcing the air out through the upper chamber.

FIG. III—Median section, knee-breast posture, showing the pelvic cavities dilated with air, and the cystoscope in position for obtaining the measurements of the vertex, posterior wall, and left lateral wall.

FIG. IV—Median section, knee-breast posture, showing the anatomical relations of the pelvic organs when the rectum, vagina and bladder are dilated with air. (Multipara.)

## SUMMARIES OR TITLES OF PAPERS BY MEMBERS OF THE HOSPITAL AND MEDICAL SCHOOL STAFF APPEARING ELSEWHERE THAN IN THE BULLETIN.

HOWARD A. KELLY, M. D. Exploration of the Abdomen as an adjunct to every Celiotomy.\*

I had occasion on several instances some sixteen years ago to make a post-mortem examination and to remove various viscera which I was desirous of inspecting, through the vaginal vault in

women and the perineum and rectum in men. These experiences showed me that it is easy to reach all the viscera through an incision as far as possible from the centre of the abdomen, large enough to admit the forearm, and suggested the propriety or rather the necessity of making a somewhat analogous investigation of all the abdominal organs in the living subject every time the abdomen is opened.

The routine examination of the abdominal and pelvic viscera in all celiotomies, where it does not endanger the life of the patient,

\*A more extended consideration of this subject appears in the *Medical News*, December 16, 1899.

will commend itself to a surgeon for a number of excellent reasons, some of which are the following:

First, as abdominal diseases are commonest in middle life, the period when most of our celiotomies are performed, it is practically certain that the coincidence of two or more entirely independent diseases will be discovered in some instances by means of this examination.

Again, there is a constant association between certain abdominal affections and affections elsewhere, in the form of a mutual interdependence, either from the propagation of disease, as in the case of cancer, sarcoma and tuberculosis; or mechanically, where the effects of pressure are manifested near to or at a distance from the seat of disease, as in the case of pelvic tumors or inflammation obstructing the vascular, the urinary or the alimentary channels. These secondary conditions often in their initial and curable stages may be brought to light by the method of investigation here advocated.

Moreover, such an examination, if negative, gives both operator and patient a much more comfortable assurance that the convalescence will be without interruption, as well as the satisfaction of realizing that there is no visceral affection in progress which may in the near future tend to shorten life or to impair health.

The following diseases are most likely to be found in such a routine examination: appendicitis, hernia (either inguinal or umbilical), hydronephrosis, disease of the omentum, pyloric cancer, movable kidney, enteroptosis, cancer of the liver, perihepatitis, gall stones.

In making the exploration extreme care must be taken to maintain asepsis by thoroughly sterilizing the arm or, better still, by wearing a rubber glove with a long sleeve reaching as far as the elbow. If the area in the immediate neighborhood of the incision is so septic as to require the use of drainage, the operator had best forego the more extended examination. The best position of the patient for the examination is either lying flat on the table or with the pelvis slightly elevated. The structures are examined in an order which must vary with the location of the incision. When the abdominal opening is made low down over the middle of the pelvis, I commonly follow some such routine as this: After carefully noting the condition of each pelvic viscus, uterus, tubes and ovaries, bladder and rectum, I look at the inguinal and umbilical ring and if there exists a hernia I proceed to sew it up at once from the inside of the abdomen. The next point of importance requiring examination is the vermiform appendix.\* This should be removed if it shows any traces of previous inflammation. Then follows the inspection of the ureters, of great importance in gynecological operations. Every surgeon should be thoroughly familiar with the ureteral landmarks. The position of the transverse colon and the stomach is noted on account of the frequency of enteroptosis.

The operator now introduces his fore-arm and palpates both kidneys, noting their presence, size, form and mobility. A stone in the renal pelvis is readily felt. After the kidney, the liver is palpated, its apparent size, the regularity of its surface, any adhesions, which when present indicate perihepatitis, being noted, and most important the gall bladder is explored. I next put my index finger in the foramen of Winslow and trace the common duct down for several centimetres, feeling for stone.

The spleen, the pancreas, retroperitoneal lymph glands, and finally the abdominal portion of the aorta are palpated in order.

There are in general three classes of cases to which this extended examination may be applied.

First. Those in which there has been no reason to anticipate disease of any other organ and the examination is made simply as a routine procedure whenever it adds nothing to the gravity of the situation.

Second. Those cases in which, on opening the abdomen, contrary

to expectation, no disease is found near at hand. I recall a case\* of this sort in which I made an incision over the appendix, and, finding no appendicitis, enlarged the opening and discovered a gall stone within a ruptured gall bladder; also an instance in which gall stones were believed to be present, but on finding the diagnosis at fault, I introduced my arm through the enlarged incision and came upon a large hematoma of the ovary.

Third. The group of cases in which there exists a definite percentage of chances that the disease discovered at the time of operation is complicated by the affection of some other organ neighboring or remote.

REID HUNT. Direct and Reflex Acceleration of the Mammalian Heart with some Observations on the Relations of the Inhibitory and Accelerator Nerves.—*American Journal of Physiology*, II, pp. 395-470.

Experiments on dogs and cats showed that in these animals the center of the accelerator nerves is almost always in a condition of tonic activity and that the normal rate of the heart is determined in part by this tonic activity. Section of the accelerator nerves sometimes causes the heart to become irregular; this is especially true if the irritability of the heart is low. The most important functions of the accelerators seem to be connected with their tonic activity.

Long-continued stimulation of the accelerators causes fatigue and sometimes even death of the heart. If the vagi are in tonic activity, or if they are stimulated simultaneously with the accelerators, the latter cause less fatigue of the heart.

Reflex acceleration might be caused either by increasing the activity of the accelerators or by decreasing the tonic activity of the vagi. The latter was found to be the usual if not the exclusive method. Reflex acceleration was never obtained after section of the vagi although the accelerators were intact, but was readily obtained if the vagi were intact although the accelerators were cut.

It seems very probable that most cases of rapid heart action (voluntary acceleration, acceleration during muscular exercise and after the administration of drugs, the rapid heart of paroxysmal tachycardia etc.) so far as they are dependent upon the extracardiac nerves, are largely due to diminution of the tonic activity of the vagi and not to a stimulation of the accelerators; in paroxysmal tachycardia especially the entire course of the acceleration is markedly different from the effects of stimulating the accelerator nerves in animals.

W. S. BAER, M. D., P. M. DAWSON, M. D., and H. T. MARSHALL, M. D. Regeneration of the Dorsal Root Fibres of the Second Cervical Nerve within the Spinal Cord.—*Journal of Experimental Medicine*, January, 1899.

LEWELLYS F. BARKER, M. B. Progress of Neurology.—*Philadelphia Medical Journal*, January 23 and February 4, 1899.

— A Case of Glioma of the Lower Cervical Region of the Spinal Cord Producing a Total Transverse Lesion, in which there was Spasticity of the Lower Limbs and Persistence of the Deep Reflexes. A Study of a Peculiar Form of Degeneration (Degenerative Micans) met with in this Case.—*American Journal of the Medical Sciences*, Vol. 117.

SIMON FLEXNER, M. D. Some Points in the Pathology of Syringomyelia.—*American Journal of the Medical Sciences*, Vol. 117.

— Hodgkin's Disease.—*American Journal of the Medical Sciences*, Vol. 118.

THOMAS B. FUTCHER, M. B. Lipemia in Diabetes Mellitus.—*The Journal of the American Medical Association*, Vol. 33.

— A Critical Summary of Recent Literature Concerning the Mosquito as an Agent in Transmission of Malaria.—*American Journal of the Medical Sciences*, Vol. 118.

\* The method I follow in reaching the various organs is detailed in loc. cit.

\* For description of cases, see loc. cit.



HENRY HARRIS, M. D. Preparation of the Abdomen for Operation.—*American Journal of Obstetrics*, Vol. 40.

HOWARD A. KELLY, M. D. A New Method of Treating Complete Tear of the Rectovaginal Septum by Turning Down an Appear into the Rectum and by Buried Suture through the Sphincter Muscle. (Illustrated).—*Medical News*, Vol. 75.

— New Handle and Grip for Scissors in Plastic and Other Work.—*American Journal of Obstetrics*, Vol. 40.

— Operation for Complete Tear of the Perineum.—*American Journal of Obstetrics*, Vol. 40.

— The Reflux of Air into the Ureters through the Air-Distended Bladder in the Knee-Breast Posture.—*American Journal of Obstetrics*, Vol. 40.

— Some New Instruments to Facilitate the Operation of Myomectomy.—*American Journal of Obstetrics*, Vol. 40.

— The Use of the Renal Catheter in Determining the Seat of Obscure Pain in the Side.—*American Journal of Obstetrics*, Vol. 40.

J. H. MASON KNOX, JR., PH. D., M. D. On Supra-arterial Epicardial Fibroid Nodules.—*The Journal of Experimental Medicine*, March, 1899.

JOHN BRUCE MACCALLUM, M. D. A Contribution to the Knowledge of the Pathology of Fragmentation and Segmentation, and Fibrosis of the Myocardium.—*The Journal of Experimental Medicine*, May-July, 1899.

FRANKLIN P. MALL, M. D. Liberty in Medical Education.—*Philadelphia Medical Journal*, April 1, 1899.

JOSEPH LONGWORTH NICHOLS, M. D. A study of the Spinal Cord by Nissl's Method in Typhoid Fever and in Experimental Infection with the Typhoid Bacillus.—*The Journal of Experimental Medicine*, March, 1899.

EUGENE L. OPIE, M. D. A Case of Hæmochromatosis. The Relation of Hæmochromatosis to Bronzed Diabetes.—*The Journal of Experimental Medicine*, May-July, 1899.

WILLIAM OSLER, M. D. An Acute Myxœdematous Condition, with Tachycardia, Glycosuria, Melæna, Mania and Death. *The Journal of Nervous and Mental Diseases*.

— In Memoriam William Pepper. *Philadelphia Medical Journal*, March 14, 1899.

— The Cavendish Lecture on the Etiology and Diagnosis of Cerebrospinal Fever.—*The Boston Medical and Surgical Journal*, Vol. 141.

— The Clinical Features of Sporadic Trichinosis.—*American Journal of the Medical Sciences*, Vol. 117.

— The Diagnosis of Typhoid Fever. A Discussion at the New York State Medical Association, October 25, 1899.—*New York Medical Journal*, Vol. 70.

OTTO G. RAMSEY, M. D. The Early Use of Purgatives after an Abdominal Section.—*American Journal of Obstetrics*, Vol. 40.

H. O. REIK, M. D. The Sterilization of Instruments with Formaldehyde.—*Philadelphia Medical Journal*. February 4, 1899.

W. S. THAYER, M. D., and JESSE WILLIAM LAZEAR, M. D. A Second Case of Gonorrheal Septicæmia and Ulcerative Endocarditis with Observations upon the Cardiac Complications of Gonorrhœa.—*Journal of Experimental Medicine*, January, 1899.

J. WHITRIDGE WILLIAMS, M. D. Anti-Streptococcus Serum.—*American Journal of Obstetrics*, Vol. 40.

— A Case of Spondylolisthesis.—*American Journal of Obstetrics*, Vol. 40.

## PROCEEDINGS OF SOCIETIES.

### THE JOHNS HOPKINS HOSPITAL MEDICAL SOCIETY.

Monday, November 20, 1899.

The meeting was called to order by the President, Dr. Henry M. Thomas.

#### Cases Illustrating Forms of Pigmentation of the Skin.—Dr. OSLER.

CASE I. *Addison's Disease*.—A man, aged 40, was admitted a few days ago, complaining of weakness, pain in the stomach and bowels, and a gradual pigmentation of the skin. He had been a man of good habits and of good health until five years ago, when he began to have gastric trouble, chiefly regurgitation of the food. About four years ago he began to have pains below the costal margin and radiating over the abdomen. They came on in paroxysms three or four times in the course of the year, and were sometimes accompanied by vomiting. During this time his complexion grew steadily darker, and within the past twelve months his condition has grown worse. He has paroxysms of sudden pain, chiefly about the right costal margin, followed by vomiting, headaches and at times great prostration. These paroxysms are preceded by twitchings of muscles of the limbs, especially of the arms, so marked that he has not been able to write. After these spells the prostration is extreme and at times he has

hardly been able to move in bed for nearly a week. Each spell leaves him weaker and he has not done a day's work for a year. The vomiting has averaged once a day during the past year, and yet his appetite is excellent. He has never had any diarrhœa. He looks somewhat emaciated and has lost fifteen or twenty pounds. The face, hands, and more particularly the body, are uniformly pigmented. There is slight pigmentation of the mucous membrane of the gums. His pulse is slow but not feeble and the blood count shows 6,000,000 red cells.

The combination of symptoms presented by this man is characteristic of Addison's disease, yet the case is somewhat peculiar. There is no history of tuberculosis; there is no reaction to tuberculin, and the duration of four or five years is rather unusual, the disease being as a rule very much shorter. Asthenia, such as he describes, a prostration of such a degree as to render him unable to turn in bed, or even to move, is most characteristic, and in fact the diagnosis may sometimes be made on the asthenia and gastro-intestinal symptoms without pigmentation.

CASE II. *Hæmochromatosis* (?).—This had presents a still more remarkable and very much more unusual condition. This boy came here in April, 1896, with malaria and looking as if he had had a malarial cachexia of long duration. He had not been ill long, but looked so bronzed and pigmented

that we commented upon it in the history. We could not reasonably explain this pigmentation, but thought he must have had malaria longer than shown by his history. He came to the hospital again in February, 1897, with tertian malaria, and he was this time even more pigmented, but I forget whether at that time we noted any enlargement of the liver. In September, 1899, he appeared again with an acute psoas abscess, and at that time we found that he had an enlarged liver and spleen. Meantime we had been educated at the Society by Dr. Eugene L. Opie on the subject of hæmachromatosis, and this case corresponds in certain features with that remarkable disease. He has had no asthenia, no feebleness of pulse or muscular weakness, and no trace of gastrointestinal disturbances, though those features have been sought for very carefully.

His pigmentation, as you see at present, is extreme, being quite marked in the face, and there is a little pigmentation of the mucous membrane at the margin of the lips. This bronzing has grown gradually deeper, so that he looks to-day more bronzed than he was in September. The liver is moderately enlarged and can be felt two or three finger breadths below the costal margin. The edge of the spleen is only just palpable. There is no sugar in the urine. Very possibly the condition is that of hæmachromatosis.

We have had a case of this remarkable disease which is characterized by progressive pigmentation of the skin and internal organs with hypertrophic cirrhosis of the liver, sclerosis of the spleen and finally of the pancreas with the pancreatic form of diabetes. The majority of these cases have been described under the name of Bronzed Diabetes. The disease was fully described by Dr. Opie in the last number of the *Journal of Experimental Medicine*.

CASE III. *Melanoderma in chronic myocarditis*.—We can not say that all cases of progressive pigmentation of the skin are either due to hæmachromatosis or to Addison's disease, for there are certain conditions, particularly certain forms of chronic heart disease, some cases of chronic nephritis, etc., in which pigmentation of the skin develops and increases, and occasionally is accompanied even by pigmentation of the mucous membranes.

This man has been under observation for several years, having been admitted first in January, 1891, and nine times since, always with the same symptoms—shortness of breath, extreme irregularity of the pulse, dilated heart and sometimes with slight swelling of the feet. He has chronic myocarditis and progressive pigmentation of the skin. His face has deepened in color and the general surface of the body is pigmented. There is no pigmentation of the mucous membranes and though he has had extremely feeble and irregular pulse, he has not had the asthenia which characterizes Addison's disease. He has no enlargement of the liver or spleen. A piece of skin was removed for examination by Dr. Opie, but we have not yet received his report.

The diagnosis between the pigmentation of the skin in Addison's disease and in hæmachromatosis can be readily made, as the pigment in the latter case is an iron containing one and is found in abundance in the skin and also in the cells of the sweat-glands.

CASE IV. *Melanoderma in Anæmia Splenica*.—Dr. Osler then referred briefly to a fourth cure of pigmentation of the skin, at present in the private ward. The young man had enlarged spleen and anæmia of the chlorotic type and gradual pigmentation of the skin. Several of the cases of splenic anæmia which had been under observation of late years have presented an extreme degree of melanoderma.

**A Case of Purulent Leptomeningitis Associated with Acute Endocarditis due to Infection with the Micrococcus Lanceolatus.**—DR. FUTCHER.

The specimens which Dr. Barker will show were interesting on account of the number of complications that developed during the clinical course of this case in the wards. The patient came into the hospital November 5, complaining of shortness of breath. There was nothing special in the past history of the patient, nor in the family history. Seven years ago the patient had an attack of rheumatism and he gave a history of severe headache lasting about six weeks previous to admission and so intense that he was totally incapacitated for work. During this time he had frequent chills believed to be of malarious origin. Two weeks before admission he developed severe shortness of breath, cough and expectoration of bloody sputum. Later he had marked œdema of the feet and some general anasarca. On admission he was in marked distress, quite dyspnoic, somewhat cyanotic and presented the physical signs of aortic and mitral insufficiency. The sputum was tenacious and tinged with bright blood, such as one sees in cases of lung infarction. There was an area of consolidation over the middle lobe on the right side with typical tubular breathing and a pleuritic friction rub extending into the axillary region. The heart symptoms persisted for several days, the temperature during this time being irregularly elevated, running as high as 101.5°. During his illness he complained of severe pain in the region of the spleen, and splenic infarction was diagnosed. Nothing of special importance happened until the night of November 12, when his temperature arose 7.5 degrees inside of eight hours. The next morning he was semi-unconscious and it was found that he had distinct rigidity of the arms and legs with exaggeration of the knee-reflexes. On the 16th Doctor Osler suggested lumbar puncture and 15 cc. of slightly turbid fluid were obtained, which showed typical lanceolate diplococci in large numbers, but none of them intracellular. This of course clinched the diagnosis. Two days later he developed a conjunctivitis, and smears from this secretion also showed the typical lanceolate diplococci. About 24 hours before death there was complete steaminess and opacity of the right cornea. He died on November 18, the temperature being 106.4° at the time of death.

It was suspected that we would find at autopsy chronic endocarditis, with a supervening acute endocarditis, an infarction of the middle lobe of the right lung as well as of the spleen and a pneumococcus meningitis.

**Exhibition of the Organs.**—DR. BARKER.

The organs from this case are of more than ordinary interest. The autopsy confirms in almost every point the clinical diagnosis. The body 170 cm. long was that of a strong individual, moderately emaciated. Rigor mortis was

well marked and there was livor mortis in dependent parts. The peritoneal cavity was dry, and free from old adhesions. The diaphragm on the right side reached as high as the fourth intercostal space; on the left side to the fifth rib. There were a few firm old adhesions at the posterior margin of the left pleural cavity. On the right side the costal and visceral pleuræ were slightly adherent, especially over the middle lobe and the middle part of the upper lobe. The adhesions on the right side are all recent and fibrinous. This cavity is free from old fibrous adhesions. The pericardium aside from one old patch of thickening shows no alterations. The heart is much enlarged, weighing 418 grammes. In the right atrium the valve of the coronary sinus is remarkably developed, forming a large, thin, multiply perforated membrane. The cavities of the heart are somewhat dilated and the walls are thickened. On opening the left ventricle the bicuspid valve is found to measure 10.4 cm. in circumference. At the base of the anterior cusp of the valve on the atrial surface at its right extremity is a bulging area measuring 12 x 7 mm. and protruding for a distance of from 3-4 mm. above the surface of the valve, showing the endocardium before it. On puncture yellowish-green pus exuded and the swelling disappeared. The posterior cusp is shorter than normal, but otherwise shows no alterations. On the ventricular surface of the anterior cusp close beneath the posterior semilunar valve of the aorta there is a small ulcerated area, the margins and base of which are necrotic. Fibrin is deposited upon the surface of the ulcer. The introduction of a probe shows direct continuity with the abscess described on the atrial surface of the valve. In the aortic semilunar valves there are both old and recent changes. The old alterations consist in the main of fusion of the adjacent edges of the posterior and right semilunar valves. The edges of the two valves corresponding to this fusion are very much thickened and the lunulæ have disappeared. The lunula on the left side of the posterior cusp is intact and normal, while that on the right side has disappeared, and the valve is much thickened and retracted below it. The left lunula of the right semilunar valve is present, but considerably thickened, while the right lunula of this valve has entirely disappeared and the main body of the valve close to it is thickened. The adherent valves are, in the region of the adhesion practically immobile, owing to formation of new connective tissue and partial calcification. This change in the valve must have caused a relatively high degree of insufficiency and a slight stenosis. In the left aortic semilunar valve there has been apparently no chronic change except for slight thickening of the edge of the lunula. On the ventricular surface of the valve, however, there is distinct evidence of recent acute alteration. Here one sees a large flat ulcer, 1 cm. in diameter, to which flakes of fibrin are adherent. On the aortic surface of the same valve there is also an area of necrosis with deposition of fibrin. The trabeculæ carneæ are more prominent than normal in the left ventricle. The endocardium, especially over the septum, is slightly roughened and granular. At the root of the aorta there are some reddish and yellowish patches, elevated, which on section, are of a yellow color and opaque. The myocardium is in general pale brown

in color, and no areas of scarring myocarditis are visible to the naked eye. The left coronary artery shows a few patches of arteriosclerosis in the descending ramus and also in the circumflex ramus. The right coronary artery also contains patches of sclerosis.

In the middle lobe of the right lung there is a large hæmorrhagic infarction surrounded by an area of fresh consolidation. Coverslips from the consolidated area show large numbers of pneumococci. The acute fibrinous pleurisy apparently had its origin by extension from the consolidated region of the lung. The left lung is emphysematous along its anterior margin and at the apex. There is only moderate coal pigmentation. Both lungs show the typical changes of chronic passive congestion.

The kidneys show a slight degree of chronic diffuse nephritis, the capsule being somewhat adherent and the cortical substance diminished in amount. Frozen sections also show the changes of acute parenchymatous degeneration. In the organs of the abdomen there is little remarkable with the exception of the changes of chronic passive congestion and the existence of a small hæmorrhagic infarction at the inferior extremity of the spleen.

On removal of the calvarium the dura mater was found to be unusually adherent, but otherwise normal. The superior sagittal sinus contains in its anterior part a few decolorized blood-clots, evidently *ante-mortem*, loosely adherent to arachnoidal granulations which project into the lumen of the sinus. At the base of the brain the arachnoid is raised from the underlying pia by a collection of pus several millimetres in depth. The pus contains large numbers of encapsulated pneumococci and many empty capsules. The very purulent area extends from a point 10 cm. in front of the optic chiasm backwards as far as the middle of the ventral surface of the cerebellum, the breadth of the area averaging as much as 8 cm. Pus is also abundant in the Sylvian fossa concealing the blood-vessels. While the process is most marked at the base of the brain, it is by no means confined to it, for if one looks at the lateral surfaces they are found also to be more or less involved. The deeper sulci on the lateral surface contain visible pus, but over the gyri themselves very little pus is observable, although the vessels of the pia arachnoid are everywhere intensely congested.

On opening the spinal canal a small hole was found in the dura in the lumbar region corresponding to the lumbar puncture made during life. The internal surface of the dura is smooth and glistening and aside from slight capillary ectasis shows no alterations. The subarachnoid cavity of the dorsal surface of the lumbar part of the spinal cord contains in many places accumulations of pus. The areas where pus is visible vary in size, some being much larger than others. The whole dorsal surface of the cord is more or less bathed in yellowish green pus. The pus is especially abundant in the thoracic part of the cord, but there is also a considerable amount in the cervical region. The pial blood-vessels are everywhere markedly injected. The spinal nerves do not appear to be especially involved in the inflammation, but along the cerebral nerves pus can be easily followed. It was especially abundant in the course of the cochlear and vestibular nerves. The possibility of middle-ear disease was of course suspected, but both ears



were carefully opened and no evidence of a primary process there could be found. Pus could be followed along the left optic nerve into the orbit and the eye when removed showed a general purulent inflammation. Radiating from the point of entrance of the ophthalmic artery yellowish lines could be followed along the vessels between the retina and the chorioid coat. The vitreous body and the crystalline lens were turbid from infiltration with pus, coverslips from which showed large numbers of pneumococci and no other micro-organisms. The iris, cornea and conjunctiva were also acutely inflamed.

**ANATOMICAL DIAGNOSIS:** *Leptomenigitis cerebrospinalis purulenta; panophthalmitis purulenta acuta; endocarditis ulcerosa maligna; endocarditis valvularis chronica; hypertrophica et dilatatio cordis; arteriosclerosis aortae et aa. coronariorum; infarctio pulmonis dextrae; pneumonitis et pleuritis acuta; pleuritis chronica adhaerens; congestio chronica passiva; infarctio lienis; degeneratio parenchymatosa renum; nephritis chronica diffusa incipiens.*

As has been said the pneumococcus was found in the pulmonary infarction and the consolidated lung about it; in the purulent inflammation of the eye; in the purulent exudate in the brain and spinal cord, and in the ulcers and abscess on the valves of the heart. Dr. Harris recovered the coccus in cultures. It is of interest to trace the probable sequence of events in the case. The chronic valvular endocarditis doubtless dates back to the attack of rheumatism from which the patient suffered seven years ago. Resulting from the old endocarditis and aortic insufficiency came hypertrophy of the heart accompanied, doubtless at times, by dilatation of its chambers. The chronic passive congestion of the lungs and other organs is obviously the result of the cardiac disease. It is probable that the chronic circulatory disturbance and the changes produced by it in the organs, made the individual unusually susceptible to infection. The question arises which of the several local infections from which the man suffered was primary. The clinical evidence is in favor of a primary endocarditis with complicating meningitis. It seems to me impossible to say, however, from the autopsy findings alone which is primary, the meningitis or the endocarditis. The infarction of the spleen is easily explicable when one remembers the ulcerative endocarditis in the left heart. The infarction of the lung can scarcely be referred to the heart directly, for there is no acute endocarditis on the right side of the heart, nor did the cavities of the heart contain thrombi of any kind. The most probable explanation seems to me to be that of the thrombi which formed in the superior sagittal sinus of the brain and were very loosely adherent, one passed into the venous current and by way of the right heart entered the pulmonary artery as an embolus leading to the pulmonary infarction. Pneumococci being in the blood, the pneumonic infiltration in the periphery of the infarct is easily accounted for. It is not to be forgotten, however, that there is much evidence in favor of the view that pulmonary thrombosis can occur as the result of local processes in the walls of the pulmonary artery without the occurrence of embolism. The whole subject is fully discussed in the article on thrombosis and embolism in Clifford Albutt's System of Medicine.

## NOTES ON NEW BOOKS.

**The Nervous System and Its Constituent Neurones.** By LEWELLYS F. BARKER, M. B. TOR., Associate Professor of Anatomy in the Johns Hopkins University; Assistant Resident Pathologist to the Johns Hopkins Hospital. (D. Appleton & Co., New York, 1899.)

In 1897 Dr. Barker began a series of anatomical papers in the *New York Medical Journal* for the purpose of presenting some of the most important recent discoveries relating to the nervous system. He had little idea at the commencement of his work that these papers would form a book of more than a thousand pages. For nearly two years articles on the anatomy of the nervous system appeared from Dr. Barker's pen, at irregular intervals, until the writer realized that should his method be continued, an end of his work could hardly be attained. The intense activity of investigators in this domain makes the task of keeping abreast of their discoveries a difficult one. Dr. Barker decided, therefore, that a book would be the best form in which to present the results of his labors. He accepts the neurone concept without hesitation and makes it the foundation of his work.

The book is divided into six sections, of which the last comprises much more than half of the entire volume. In these sections are considered the history of the development of the neurone concept, the external morphology of the neurones, the histogenetic relations of the neurones, the neurone as the unit in physiological and pathological processes, and the grouping and chaining together of neurones in a complex nervous system like that of man and the higher animals.

In criticizing any book it is only fair to the author that we should constantly bear in mind the object he has had before him. Dr. Barker's book is chiefly a review of the work of others, but it is a review by a man of excellent critical ability who knows how to sift the good from the bad and to present in strong light the important features of many valuable papers. It is not a book containing merely the results of Dr. Barker's original investigations, although throughout the work the author's hall-mark is found, and in many places a statement of his views on the opinions quoted from others. We find also evidences that the microscope has been diligently employed by him, and that a very large amount of literature has been carefully studied.

Dr. Barker begins his book with a brief account of the imperfect knowledge of the nervous system existing fifty or sixty years ago, and shows how, step by step, information has been gained. It is interesting to review this history. We are too prone to accept the achievements of the past without recognition of the laborious methods by which they were made possible. We find a brief account of the rise of the silver method—but not the fall, as some overzealous writers would have us believe—and the methylene-blue method of Ehrlich, that has never been so extensively employed as its value warrants, is described. Dr. Barker is one of the strongest defenders of the neurone concept. The independence of the neurone, he says, has apparently, at least so far as embryonic tissues are concerned, had its complete anatomical justification, and even granting the claims of Held, Apáthy and Bethe, the general validity of the doctrine of the individuality of the neurones would not be affected.

Van Gehuchten is said to have found changes in the terminal nucleus of a sensory nerve after sensory axones of the first order were cut—similar changes to those that occur in motor neurones. This is true, but it should be mentioned that Van Gehuchten himself later questioned the correctness of his former interpretation. The findings of Marinesco in regard to this question are said by Dr. Barker to have been curiously enough misinterpreted. Marinesco however, seems to have been correct, for Van Gehuchten has demonstrated by the silver method that the cells of the posterior nucleus of the vagus send their axis cylinders towards the periphery of the medulla oblongata, and that this posterior nucleus is motor. We need more evidence before we can accept the statement that

changes similar to those in motor cells occur in the cell bodies of the second sensory neurones after diversion of the axis cylinders of the peripheral sensory neurones.

A brief but excellent account of Apáthy's work is given. We feel that a great truth has been only partially revealed to us when we study Apáthy's writings. Whether or not Apáthy's and Bethle's statements will force us to abandon the neurone theory, the future alone can show. We must acknowledge that this concept depends on the results obtained by various methods, and that it seems impossible to explain certain findings by any other theory at present known to us; and yet the writer of this review would hardly care to say with Dr. Barker that the validity of the neurone concept has been so firmly established that it can never be utterly overthrown. The downfall of the Roman empire seemed impossible at one period, and some of the best-established theories have fallen before the revelations of science.

Dr. Barker gives Nissl's classification in as simple a form as possible. The students of medicine—for whom in part this book is written—who will carry these types in their memories do not exist in every medical school. Dr. Barker's résumé of the views held in regard to the nerve-cell is excellent. We should hardly expect that everything of importance written on this subject could be crowded into a few pages of a text-book, but the author has performed the task he set for himself; he has given a brief résumé of the work of others and an expression of opinion regarding the relative value of this work, and possibly he has given more than most students will easily grasp.

The chapters on embryology are concise and contain the most important facts. The description of the metameres is of especial value at this time, on account of the importance attributed to them in disease by certain writers. The metameres appear in the embryo as sharply defined masses in the mesoderm lateral from the chorda dorsalis and the medullary tube. A spinal nerve with its sensory and motor roots, spinal ganglion and portions of the medullary tube to which it belongs, represents a neurotome. Briessaud has recently explained many cutaneous diseases and other conditions by a theory based on the metameres. The description which Dr. Barker gives of the shifting of the diaphragm and the explanation thereby of how an abdominal muscle is supplied by a cervical nerve, are very interesting.

Dr. Barker, in his chapters on the physiology of the neurone refers to facts which are almost incomprehensible; such, for example, as the production by the activity of the neurones of chemical compounds of a degree of complexity scarcely approached elsewhere on this planet; or the preservation of memory in certain cells notwithstanding the constant changes of structure, which he expresses in the words "Dauer in Wechsel." We have in this latter statement a mystery the human mind is unable to solve. Marinesco has recently written on this subject. According to his view, the duration of a nerve-cell is as long as the duration of the organism. " \* \* \* 'C'est grâce à cette fixité des cellules nerveuses que la vie psychique est possible. C'est cette propriété remarquable qui nous explique également la transmission héréditaire de certaines propriétés vitales de l'organisme. Si, en effet, les cellules nerveuses devaient sans cesse se trouver en voie de multiplication, il serait bien difficile de pouvoir expliquer la persistance remarquable de nos souvenirs, de la formation de nos idées; la transmission de l'immunité, etc.'" A nerve-cell may change, may grow, but there is still a "Dauer in Wechsel."

It may be permissible to correct a slight error that has crept into Dr. Barker's book. In referring to a paper by Dejerine and Spiller, Dr. Barker says that these writers contest the extension of endogenous fibers into the median triangle of Gombault and Philippe (p. 458); on the contrary, the words of Dejerine and Spiller are: "Le triangle médian de MM. Gombault et Philippe contient—à côté de fibres endogènes dont l'existence est très probable—un grand nombre de fibres exogènes ou radiculaires."

The central pathways of cranial nerves have only in slight extent been determined. This is well shown by a study of the vestibular nerve, although more knowledge has been acquired regarding the cochlear nerve. Even the most recent studies leave much to be desired. The acoustic pathway has been a favorite subject with Dr. Barker and he has written on it previously.

Dr. Barker believes that the consensus of opinion is that the function of the posterior columns of the cord is the conduction of the so-called muscular sense and not of tactile sense. In regard to tactile sense we are more uncertain. He believes that all the centripetal fibers in the inner capsule occupy the posterior part of the pars occipitalis. This view, however, is disputed by Dejerine. He agrees with Dejerine and some other investigators in teaching that most of the sensory neurones are interrupted in the optic thalamus. Little is known of the central neurones of the gustatory conduction paths, and Dr. Barker dismisses the subject in a few lines. If we compare the space allotted to the discussion of these fibers with that given to the discussion of the central olfactory tract, we realize that the latter pathway is exceedingly complex and that it is among the most difficult structures of the central nervous system to understand.

All through the book references are made to Miss Sabin's reconstructions of tracts and nuclei. This is a recent and valuable mode of studying the central nervous system, and Miss Sabin has been one of the most active workers in this field. We have an excellent proof of the value of this work in the picture of the lower olive given on page 958. A picture like this conveys a better idea of the convolutions of this body than can be obtained from a study of microscopical sections. This reconstruction demands time and care, and we read therefore with some surprise the numerous references to the extensive work Miss Sabin has accomplished.

The chapter on the central visual neurones is a very interesting one. The inaccuracy of the term "optic nerve" is pointed out, but no attempt at change—and we think the omission is wise—has been made. "Optic nerve" does not lead to the confusion that "ascending root of the fifth nerve" causes. We are somewhat surprised that the work of Vialot on the optic tracts and centers receives such scant recognition. The pupillary fibers of the optic tract and optic nerve are mentioned, but nothing is said of the extraordinary statements of Massaut concerning degeneration of these fibers.

All the important recent literature on the centers of the "upper facial" and "lower facial" nerves is not given. The investigations of Marinesco and Van Gebuchten show that the "upper facial" nucleus is a part of the pontile facial center and not a part of the oculomotor center. Marinesco has published within the past few months a second paper on this subject containing the results of his latest investigations and confirming his former statements in their most essential details.

Too much praise of the form in which this book has come from the press cannot be given. The volume is a beautiful example of the printer's art. The illustrations are numerous and well chosen. The author's style is fluent, and it is evident that Dr. Barker is a master of the English language. This book is one of which we may well be proud, and it can be said with truth that it contains the results of the most recent scientific investigations on the nervous system. We regret that the sympathetic system is passed over in silence, and express the hope that this deficiency may be remedied by the appearance of a separate monograph. W. G. S.

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*Second Report of the Sewerage Commission of the City of Baltimore.* Consisting of Mendes Cohen, F. H. Hambleton, E. L. Bartlett. Appointed by joint resolution of the City Council approved 25th May, 1893, and continued by joint resolution approved 18th March, 1898. 135 pages. 8vo. 1899. Baltimore.

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*A Text-Book of Diseases of the Nose and Throat.* By D. Braden Kyle, M. D. With 175 illustrations, 23 of them in colors. 1899. 8vo. 646 pages. W. B. Saunders, Philadelphia.

*The Treatment of Pelvic Inflammations Through the Vagina.* By William R. Pryor, M. D. With one hundred and ten illustrations. 1899. 8vo. 248 pages. W. B. Saunders, Philadelphia.

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In the methods of instruction especial emphasis is laid upon practical work in the Laboratories and in the Dispensary and Wards of the Hospital. While the aim of the School is primarily to train practitioners of medicine and surgery, it is recognized that the medical art should rest upon a suitable preliminary education and upon thorough training in the medical sciences. The first two years of the course are devoted mainly to practical work, combined with demonstrations, recitations and, when deemed necessary, lectures, in the Laboratories of Anatomy, Physiology, Physiological Chemistry, Pharmacology and Toxicology, Pathology and Bacteriology. During the last two years the student is given abundant opportunity for the personal study of cases of disease, his time being spent largely in the Hospital Wards and Dispensary and in the Clinical Laboratories. Especially advantageous for thorough clinical training are the arrangements by which the students, divided into groups, engage in practical work in the Dispensary, and throughout the fourth year serve as clinical clerks and surgical dressers in the wards of the Hospital.

## REQUIREMENTS FOR ADMISSION.

As candidates for the degree of Doctor of Medicine the school receives:

1. Those who have satisfactorily completed the Chemical-Biological course which leads to the A. B. degree in this university.
2. Graduates of approved colleges or scientific schools who can furnish evidence: (a) That they have acquaintance with Latin and a good reading knowledge of French and German; (b) That they have such knowledge of physics, chemistry, and biology as is imparted by the regular minor courses given in these subjects in this university.

The phrase "a minor course," as here employed, means a course that requires a year for its completion. In physics, four class-room exercises and three hours a week in the laboratory are required; in chemistry and biology, four class-room exercises and five hours a week in the laboratory in each subject.

3. Those who give evidence by examination that they possess the general education implied by a degree in arts or in science from an approved college or scientific school, and the knowledge of French, German, Latin, physics, chemistry, and biology above indicated.

Applicants for admission will receive blanks to be filled out relating to their previous courses of study.

They are required to furnish certificates from officers of the colleges or scientific schools where they have studied, as to the courses pursued in physics, chemistry and biology. If such certificates are satisfactory, no examination in these subjects will be required from those who possess a degree in arts or science from an approved college or scientific school.

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### CONTRIBUTIONS TO THE SURGERY OF THE BILE PASSAGES, ESPECIALLY OF THE COMMON BILE-DUCT.\*

By W. S. HALSTED, M. D., *Baltimore, Surgeon-in-Chief to the Johns Hopkins Hospital, Professor of Surgery in the Johns Hopkins University.*

Just now I am very much impressed with the splendid results of operations for gall-stones in the common duct, for we have had of late a series of cases very desperately ill, and so transformed by their emaciation and discoloration, and so feeble in body and mind, that I could hardly picture to myself the various stages of metamorphosis toward convalescence. Every one has seen a patient whose life has been despaired of convalesce from acute disease; they watched his rapid decline and expected an almost equally rapid recovery; but when the decline has covered a period of five or ten or perhaps twenty years the changes wrought are so great and apparently of such permanent character that the complete restoration to health is the more astonishing. The large cirrhotic liver, the dry slate-yellow skin, the enfeebled intellect, the body emaciated to the last degree, seem at times almost to preclude all hopes of recovery to the practitioner who has not witnessed the changes so quickly brought about by nature as soon as the mechanical obstacles to recovery have been removed by the surgeon. What nature accomplishes without the surgeon's aid in her attempts to rid herself of the obstruction in the gall-passages and to

repair self-inflicted damage is marvelous; but her methods are very crude and attended with much suffering and great danger, immediate and remote. I have, however, in mind at this moment two particularly creditable examples of nature's surgery.

In the first one the gall-passages were shortened to just the length of the two large stones which completely filled them. One occupied the gall-bladder, the other the pancreatic portion of the common duct; the duodenum was not only adherent to the gall-bladder, but served in place of its anterior wall, which had been destroyed; the stone in the gall-bladder, therefore, rested on the wall of the duodenum, which was pasted, so to speak, over the great hole in the front wall of the bladder. There was nothing that could be called cystic duct; the choleductus was almost completely covered by the duodenum; the hepatic duct was much distended, admitting easily one finger. All signs of inflammation, except its results, had disappeared. The simplest conditions had been produced, and those most favorable to the expulsion of the stones in some subsequent attack; gall-bladder and common duct were reduced to a short, wide, nearly straight tube, which bore a striking resemblance to an atheromatous aorta. The stone in the common duct was behind the duodenum and buried in its wall.

\* Read at a Meeting of the Surgical Section of the Suffolk District Medical Society, May 3, 1899.

The second patient had his first colic twenty-one years before admission to the hospital. He was never jaundiced. In the third attack, which began one month prior to operation, his temperature reached 106°. A physician aspirated pus from the distended gall-bladder about twenty-four days after the onset of the third attack, or three or four days before we operated. The gall-bladder was opened in two acts. The fluid in the gall-bladder was almost clear and not bile-stained. Diagnosis: Stone in the cystic duct. Cover-slips showed few bacilli. Cultures yielded bacillus coli communis, pure. Patient applied for re-admission in eighteen months, because he had noticed a hard body just beneath the skin in the mouth of the sinus. By simply dilating the sinus I removed four large, very dark-green, almost perfectly cylindrical stones, which were piled up upon each other in this sinus, forming a column 10 centimeters high. Nature would herself have extruded these stones which she had brought to the surface without causing the patient any discomfort.

Equally marvelous are the processes by which nature destroys all traces of her surgical handiwork. I have operated upon two cases in which perforation of the gall-passages and intestinal walls, and the expulsion of the stone, had undoubtedly occurred, but was unable in one of them to find any evidence of the perforation other than a few light and easily separable adhesions. Again, in a case of appendicitis, followed by gangrene of the greater part of the cecum and a wide preternatural anus, there were, within a year, only a few very light adhesions about a pinhole opening in the colon to tell the story. These facts are enough to make the ordinary operations for suspension of the spleen, liver, uterus, etc., seem ridiculous. Adhesions about an artificial opening fortunately never disappear. If innocent fistulae could be established, with the organs to be suspended, the problem might in a way be solved.

I wish to ask your attention to-night to a few of the unusual facts observed by us in our operations upon the bile-passages, particularly the common bile-duct. Almost every one of our common duct cases has presented us with a new fact or two which can hardly fail to interest the general practitioner, as well as those who concern themselves with the surgery of the bile-passages. To be as brief as possible, for the time is short, I will summarize at the outset some of the more noteworthy incidents observed by us in this department of surgery.

I. Dilatation of the first part of the duodenum caused by constricting adhesions; as the result, perhaps, of the dilatation, an ulcer ("distention ulcer"—Kocher) on the confines of the pylorus; the ulcer gave rise to a dissecting submucous abscess (chronic), rich in organisms because not reached by the most painstaking sterilization of the stomach. This abscess was punctured during the operation and a fatal peritonitis resulted (terminal infection), although, literally, only a drop or two escaped, and these were carefully wiped away.

II. Primary carcinoma of the duodenal papilla and diverticulum Vateri.

*First operation.*—Excision of portions of the duodenum (nearly its entire circumference), pancreas, common bile-duct and pancreatic duct in order to give the little growth, no larger than a pea, a wide berth; circular suture of the duodenum and

transplantation of the stumps of the common duct and the pancreatic duct (Wirsung's) into the line of this suture.

*Second operation.*—Cholecystosticoenterostomy by the writer's method\* for intestinal lateral anastomosis.

III. Dynamic dilatation of the first portion of the duodenum and of the pyloric portion of the stomach, corresponding accurately to the limits of a sharply-circumscribed peritonitis; gall-stones in the gall-bladder; hydrops vesicae. Case full of interest for diagnostician. Beautiful instance of circumscribed dynamic dilatation caused by local inflammation; no adhesions.

IV. Conditions suggesting hepaticocolicostenterostomy (hepaticocolicostostcholecystenterostomy) as a possible operation; common and cystic ducts reduced to fibrous cords; dilated hepatic duct and gall-bladder. Remarkable toxic (?) renal colic resembling closely intestinal colic, associated with anuria; colic and anuria entirely relieved by salt infusion.

V. Choledochotomy performed twice. The gall-bladder, which was shriveled at the first operation when two stones were probably in the common duct, was large and distended at the second operation when only one stone occupied the common duct (the ampulla). Hematemesis after the second operation.

VI. The densest adhesions that I have ever encountered in these operations, and probably the most difficult of my operations upon the bile passages. A small abscess in the midst of the adhesions; muscular coat of the duodenum converted into fibrous tissue; the exposed submucosa resembled gall-bladder so closely that the duodenum was aspirated and opened.

VII. Case illustrating the rapidity with which adhesions after perforation and extrusion of stone can be absorbed. Renal pains resembling intestinal colic (third observation of the kind within eighteen months). Tachycardia, believed to be due to toxemia of some kind (possibly benign embolism), suddenly disappeared during counting of pulse and while preparations were being made for subcutaneous infusion.

VIII. Discharge of pus and blood by mouth and rectum during severe gall-stone attack. Two years later, adhesions so extensive and so dense that the common duct was reached by a retroperitoneal route, over the right kidney. A stone in the ampulla had just ulcerated through the wall of the common duct and through its duodenal coverings.

*CASE I.*—Duodenal stenosis from gall-stones; dilatation of the stomach and of the pyloric end of the duodenum; duodenal ulcer giving rise to a dissecting abscess.—J. S., age thirty-six, admitted February 5, 1899. Never had typhoid fever. Had malarial fever ten years ago with shaking chills. Never suffered from stomach trouble until present illness. Ever since he was eight years old has had sick headaches, lasting three to four hours, once a month; these would be relieved by emptying his stomach. Has never been jaundiced nor had clay-colored stools. Present illness began very gradually. Three years ago, he noticed that his stomach would swell after eating and hardly regain its normal size before the next meal. Had more or less pain in the epigastrium, which was most marked about one hour after eating. No nausea or vomiting at first; bowels regular. About the first of last October the pain became worse, and his sick headaches were more numerous and more severe. His vomiting now began. The vomiting was accompanied by colic, so severe as to double him up. Patient was obliged to stop

\* BULLETIN of the Johns Hopkins Hospital, No. 10, 1891.

work for two weeks. He then resumed work until Christmas, since which time he has been unable to work. Patient now vomits much more frequently. The vomiting is preceded by heartburn for about three hours and much pain in the epigastrium. Patient feels greatly relieved after the vomiting. For two weeks after Christmas he had eructations of gas; none since then. Bowels usually constipated; sometimes did not move for three weeks. He still suffers much from headache. His appetite is good, but he is afraid to eat. In October, 1898, patient weighed one hundred and forty-five pounds; he now weighs one hundred and twenty-three pounds, and is very weak. Neither stools nor vomitus have ever been blood-stained. Urine normal. Stools clay-colored. Patient now jaundiced.

On palpation of the abdomen no distinct tumor can be felt, but one detects an increased resistance just to the right of the umbilicus. The stomach's longest diameter is 31 cm.; its shortest diameter, 21 cm. The lowest limit of the stomach (tympanitic) is 3½ cm. below the umbilicus. Spleen not palpable. Heart and lungs normal. Glands nowhere enlarged. Pulse slow, feeble, 60 beats to the minute.

January 24th. Test breakfast (Ewald). Two hundred and sixty cc. removed one hour later; green color; acid. Total acidity, 5.9 cc. 0.1 normal NaOH. Free hydrochloric acid; no lactic acid. No sarcinae nor *Opfer-Boas* bacilli.

February 4th. Test breakfast. Sixty cc. removed. Total acidity, 20. No hydrochloric acid; no lactic acid. A few *Opfer-Boas* bacilli (?).

February 5th. Stomach tympanitic. Clapage readily obtained. Stomach peristalsis quite marked at times. Gurgling felt over small intestines. Stomach washing with sterile salt solution, as preparation for operation, begun. Stomach holds about two liters. Cover-slip preparations show streptococci and staphylococci and numerous bacilli.

February 7th. Stomach washing continued. Cultures taken from the residual material. Cover-slips show only a few streptococci in short chains; number much decreased since February 5th.

February 8th. Only a trace of free hydrochloric acid; no lactic acid. Total acidity, 6.2 cc., 0.1 NaOH solution. Stomach peristalsis readily seen at times. Patient has been kept on sterile diet ever since his transfer to the surgical side. Has carbolic-acid gargle three times daily. Teeth cleansed three times daily with listerine and brnsh. Ingesta are boiled water, boiled milk, soft-boiled eggs, albumin. Micro-organisms seem to have entirely disappeared from the stomach, for the Petri plates are now sterile. Patient has shown great irregularity in amount of hydrochloric acid—at one time five per cent., at another zero.

February 9th. Operation.—Vertical incision through left rectus. This incision was made with the expectation of a possible gastro-entostomy. Stomach much dilated. In the region of the gall-bladder is a mass of tissue tangled by dense adhesions. In this mass are gall-bladder and pylorus. The mass feels not unlike a new growth. Search for metastases negative, but a small, hard, dark tumor, the size of a pea, is discovered in the right lobe of the liver, near its edge, evidently an angiosarcoma. Pylorus separated from gall-bladder with the greatest difficulty. The separation had to be effected with the knife. It was impossible at first to determine accurately the relations of the gall-bladder, pylorus and duodenum to each other. In the course of the dissection a pinhole opening was made in what proved to be the duodenum. The surrounding parts had been well protected against such an accident. A drop of fluid escaped, and from these cultures were taken. The little hole was immediately sutured. The gall-bladder was next opened, and not until then could it be determined positively that the pinhole opening was not in the gall-bladder, the contents of duodenum and gall-bladder so closely resembled each other; it was a thick, ropy, mucoid, colorless material. The gall-bladder was finally completely isolated. It was small and misshapen and

contained two or three hard mulberry-like gall-stones. The cystic duct contained no stones and seemed to be very short and very fine. It was surrounded by numerous small vessels, two of which were tied. There was no bile in the freely opened gall-bladder, which was drained in the usual way with a rubber tube, a catgut purse-string suture sealing the bladder hermetically about the tube. Bismuth gauze was packed about the outside of the gall-bladder. The peritoneum was closed with silk; the muscles, fascia and skin with silver. Patient bore the operation very well. At 6 p. m., temperature 101°; respirations quiet and regular. Some distention of upper abdomen.

February 10th. Patient has been vomiting. Complaints of pains in stomach and tightness across abdomen. Pulse 108 and feeble; respirations 24; temperature 101°. Leucocytes at 12.30 p. m., 26,800; at 1.30 p. m., 34,000; 5.30 p. m., 36,000; 7 p. m., 37,800. At 6 p. m. patient drowsy, quiet; respirations, 34; hands cold; pulse barely perceptible. Cover-slips show no micro-organisms in the blood. Five hundred cc. salt solution infused under each breast. At 10 p. m. 1000 cc. salt solution infused under breasts. Pulse improved, 140 to minute; low tension but regular rhythm. Respirations 36; expirations accompanied by short groans. Occasional hiccough; no vomiting; no nausea; no pain.

February 11th, 2.15 a. m. Patient died quietly.

*Autopsy.*—General peritonitis. Organisms, streptococcus pure. In the walls of the first portion of the duodenum, very near the pylorus, was an accumulation of thin mucopurulent fluid. This was held in bounds by a soft wall of granulations; it was evidently an old abscess between mucosa and submucosa, which communicated with the lumen of the duodenum by a fine opening. A minute ulcer had perhaps been the starting point.

The first portion of the duodenum was distended, and the stomach was dilated; the distention was due to the constriction produced by the adhesions, for which the gall-stones were responsible; as a consequence, perhaps, of the distention and the resulting venous stasis, a minute duodenal ulcer; and from the ulcer, the abscess, which was probably responsible for the fatal streptococcus peritonitis.

Of special interest in this case is: (1) the fact that carcinoma had been suspected—the duodenal stenosis, the dilatation of the stomach, the presence of *Opfer-Boas* bacilli (?) justified the suspicion; (2) the success which attended Dr. Cushing's efforts to sterilize the stomach; the micro-organisms had apparently entirely disappeared from the stomach on the day preceding the operation, for the Petri plates, which from day to day showed fewer colonies, for that day were sterile; (3) the dissecting intramural abscess, starting probably from an ulcer which may have been due to thrombosis of a small artery, or to distention of the first part of the duodenum, or to vascular disturbances of some kind, infectious or mechanical. Although thrombosis of a small intestinal artery does not lead to infarction it may cause hemorrhages into the lumen of the intestine and slight intramural extravasations.\*

Kocher† has demonstrated that in consequence of distention of the gut by retention of its contents and the resulting venous stasis, very considerable changes take place in the wall of the intestine. He writes as follows: "Arnd has proved that in strangulated hernias, when the circulation is greatly interfered with, micro-organisms make their way into the mucous mem-

\* Archiv für pathol. Anat. u. Physiol., 1875.

† Kocher: Mittheilungen aus den Grenzgebieten der Medizin und Chirurgie, Bd. iv, Heft 2, 1898.



brane and can pass through the intestinal wall (diapedesis of the micro-organisms). On the other hand, Cassin\* and Charrin† have shown how very important the normal epithelium of the intestine is as a protection to the intestinal wall against micro-organisms as well as ferments. The absence of this protection against ferments and bacteria leads to intoxication and infection. Finally, Reichel‡ has demonstrated that the considerable accumulation of fluid above the site of the obstruction is due in part to a hypersecretion of the mucous glands. Under the influence of the intestinal contents which, increased in amount and stagnating, are the more rapidly decomposing (the oftentimes considerable phenoluria and indicanuria is proof of the increased decomposition), the epithelium in the first place becomes destroyed because its nutrition is interfered with under the influence of the venous stasis. There result circumscribed necroses and hence ulcerations of mucous membrane, particularly in places where the venous stasis led to ecchymosis, and, finally, perforation of the serosa and peritonitis may occur. For the origin of these ulcers which, many times observed, have not been properly estimated in their relations to ileus, various explanations have been given. The most substantial explanation is the one which attributes them to the pressure of hard scybala, and it is not to be doubted that hardened fecal matter, just as foreign bodies—gall-stones, for example—can have pressure ulcers as a consequence. But the ulcers which we have pictured are certainly not dependent upon hard intestinal contents and the decubitus which they may mechanically bring about. They occur in jejunum and ileum as well as in colon by the filling up of these intestines with fluid or gas. The only factor which constantly accompanies these ulcers is overdistention of the intestine. Inasmuch as one can experimentally bring about a significant impairment of the circulation of the intestinal wall and its consequences, by overstretching of the gut, we hold to the proposition that the ulcers are best called distention-ulcers (*Dehnunggeschwüre*). Long ago I called attention to the fact that ulcers of just this kind could also in cases of strangulated hernia lead to a fatal peritonitis after constriction had been relieved, or a gangrenous loop of intestine had been resected and an entirely trustworthy suture had been made.”

CASE II.—*Primary carcinoma of the duodenal papilla and diverticulum of the Vater, successfully removed by operation; cystico-enterostomy three months after the first operation.*—Mrs. M. L., age sixty. Until August, 1897, patient was well. Her first symptom was itching of the skin, which came on suddenly and soon became severe. Patient says jaundice did not appear for nearly a month after the onset of the itching. Before the appearance of jaundice diarrhea set in, and there were six or seven stools a day which were watery and clay-colored. Patient has had no chills, no fever and no sweating. With the onset of the jaundice she noticed shortness of breath and an occasional swelling of the feet and legs. About the first of January, 1898, she had persistent bleeding of the gums for three days, following the extraction of a tooth. At times the hemorrhage was profuse.

\* Mittheilungen aus Kliniken der Schweiz, Basel, 1898.

† Fonctions protectrices de la muqueuse intestinale, Soc. de biologie, December, 1895.

‡ Zur Pathologie der Ileus, Deutsche Zeitschrift für Chirurgie.

Two months ago a tumor was noticed in the region of the gall-bladder. This tumor does not seem to the patient to have increased in size and has never been tender. In March, 1897, she had several attacks of severe pain in the epigastrium. These attacks were not accompanied by vomiting or fever or sweating. A few weeks later she had a second but milder attack. The stools were light in color for two or three days at the beginning of these attacks, but patient recalls no change in the color of the urine or the skin at that time. The daughter of the patient states that these attacks of pain were very severe, and that her mother seemed very ill.

Examination February 14, 1898.—Patient somewhat emaciated, but fairly well-nourished. Mucous membranes pale. Heart and lungs normal. There is a distinct prominence on the right side, the highest point of which is midway between the umbilicus and anterior superior spine. The prominence descends markedly with inspiration. On palpation the prominent area proves to be pear-shaped and distinctly fluctuating. The border of the liver, which reaches almost to the crest of the ileum, can be distinctly felt.

February 14, 1898. *Operation.*—Vertical incision through rectus muscle. A greatly dilated but not especially dense gall-bladder presented no adhesions. Liver projects five cm. below costal margin. Four silk sutures\* placed in fundus of gall-bladder with French needles. Small aspirator introduced in center, between sutures; syringeful of clear fluid withdrawn. Gall-bladder opened; contents evacuated. In the latter part of the fluid were many fine, sand-like, hard, greenish, round particles, suggesting miniature gall-stones. Common and cystic ducts were dilated to the size of one's thumb. A longitudinal opening two cm. long was made in the common duct. The same colorless fluid escaped from this incision. Duct explored with probe and finger. What seems to be a small, very hard stone is felt at site of ampulla. To determine the nature of this body, an incision was made through the wall of the duodenum. No glandular metastases discoverable. The stone-like body proved to be, as was feared, a carcinoma of the papilla.

*Excision of the cancerous growth.*—To give the growth a wide margin, a large piece of duodenum was excised, a wedge-shaped piece with the apex at the mesenteric border of the intestine. About three-quarters of an inch of the common duct and a shorter piece of the pancreatic duct were excised. The wound in the duodenum was closed in the usual way with mattress sutures. This was practically an end-to-end anastomosis of the duodenum. The common duct and pancreatic duct were transplanted into the duodenum along the line of suture. A linear incision into the common duct, which had been made for diagnostic purposes, was closed over a hammer. The gall-bladder was sutured to the peritoneum.

Abdominal wound closed in the usual way; the peritoneum with a running silk suture, the muscles and fascia with buried silver sutures, and the skin with a continuous subcuticular silver suture. Bismuth gauze inserted to protect the suture of the intestine and common duct. Drainage tube surrounded by bismuth gauze, and gutta-percha tissue inserted into gall-bladder and held in place by a purse-string suture of catgut. Wound dressed with silver foil. Gutta-percha tissue placed between the raw edges of the skin and the gauze packing. Operation lasted three hours and ten minutes. Patient experienced apparently no shock from the operation.

February 16, 1898, first dressing. Profuse discharge of bile in dressing. Icterus less intense. Considerable abdominal distention, but no signs of peritonitis.

\* We find this a very useful procedure. The gall bladder is manipulated by these sutures and handling is thus avoided. These sutures are of additional service when it seems advisable to distend, subsequently, the gall-bladder with fluid, and when it is desirable to close it temporarily during the operation.

February 18, 1898. Distention has almost completely disappeared. Tongue clean. Patient comfortable.

February 22nd. Discharge of bile into dressings still profuse. Stools becoming distinctly bile-stained. Icterus rapidly disappearing. Urine dark and gives bile reaction. Patient hungry.

February 27th. Skin sutures, tube from gall-bladder and the last of the bismuth gauze removed. Evacuations not bile-stained.

March 4th. Discharge of bile diminishing. Opening in gall-bladder has been plugged for several days with bismuth gauze in order to determine, if possible, whether or not the transplanted common duct is patulous. Yesterday patient vomited 125 cc. of brownish fluid.

March 5th. Patient has had a large stool, quite dark in color. There is very little leakage from the opening into the gall-bladder, which is almost closed.

March 13th. Icterus continues undiminished. Stools are still slightly bile-stained. Abdomen somewhat distended. Active peristalsis is occasionally visible through the abdominal walls. Liver still readily palpable, the right lobe extending almost to the iliac crest. Appetite good; tongue clean; no indigestion.

March 27th. Attempts to plug the opening of the gall-bladder, with the hope of forcing bile into the intestine, not satisfactory, although there is some bile in the stools. Patient's general health good. Icterus has disappeared. Patient able to walk about, and is gaining strength rapidly.

April 5th. The conjunctivæ are clear, but there remains still some evidence of bile pigment in the skin. No bile whatever in the stools, although the opening into the gall-bladder is almost closed; it is barely large enough to admit a probe. Patient is beginning to have indigestion. The appetite as a rule, however, is good. The liver is diminished in size.

April 8th. Patient complains of colic and abdominal pain. Considerable abdominal distention. Dressings bile-stained. No nausea; tongue is clear.

April 12th. Some nausea and vomiting. No distention of abdomen. Dressings very slightly bile-stained.

April 15th. Abdomen soft and relaxed, but borborygmi heard by attendant and appreciated by patient. Little or no bile in dressings.

May 5th. *Second operation: cholecystoduodenostomy, or cysticoduodenostomy.*—Suture of fundus of gall-bladder. Complete closure of abdominal wound except for drainage. Incision alongside of old cicatrix, circumscribing fistula. Gall-bladder quite small, no larger than one's thumb. Liver about normal in size. Many fine adhesions about gall-bladder, which were easily separated. Gall-bladder and ducts thoroughly exposed. The line of suture of common duct at previous operation was readily distinguishable by black-silk stitches, but it was almost impossible to find any trace of the duodenal suture. Common duct incised at site of old suture. Probe cannot be passed into the duodenum, but there is no positive evidence of the recurrence of the cancer. Unsuccessful attempts had been made before the operation to pass a probe from the gall-bladder through the common duct into the duodenum. Opening into the common duct closed in the usual way with mattress sutures over hammer. An anastomosis between duodenum and the gall-bladder or cystic duct was effected without much difficulty, although the parts to be sutured were very deeply situated and inaccessible. The duodenum was probably a little less freely movable than at the previous operation, and the gall-bladder was so much reduced in size that we were compelled to pass some of the stitches into what seemed to be the cystic duct; in any event, the neck of the gall-bladder had to be used for the anastomosis. A *bougie à boule*, passed into the gall-bladder, was used as a darning ball to assist in the placing of the sutures. All the sutures were passed (none of them tied) before the openings into the neck of the gall-bladder and duodenum were made, the method employed being that which I described many years

ago for intestinal anastomosis. The opening in the fundus of the gall-bladder was closed with mattress sutures which inverted the wall. The abdominal wound was completely closed except for protective wicks which were passed through this line of suture into the gall-bladder. What seemed to be an enlarged gland was palpated during the operation but not removed; it was forgotten. Patient suffered little or no shock from the operation.

May 6th, 4.30 P. M. Patient very restless, tossing about and occasionally vomiting. Ten P. M., has had occasional quiet naps and is more comfortable.

May 7th. Complaints of pain in back and abdomen.

May 8th. Is very comfortable. Yellow stool, containing small particles of brown fecal matter.

May 9th. Large greenish-yellow stool.

May 11th. Patient has had daily, since last note, one or two greenish-yellow soft stools. She still complains of slight pain in abdomen.

May 12th. A large, quite well-formed greenish-brown stool. Considerable flatus expelled; complains of gas in stomach. Slight nausea. Four P. M., vomited thick, mucus-like, chocolate-colored fluid containing milky curd.

May 29th. Patient complains of itching in the hands where the pruritus has always been the greatest when icterus was pronounced. No jaundice, however, is apparent.

June 8th. Slight chill, followed by rise of temperature to 39°. Trace of bile in the urine. Nausea, but no vomiting. No pain and scarcely any tenderness of the abdomen. Wound almost completely closed.

June 9th. Temperature normal; patient feels well.

In the early autumn of 1898 this patient returned to the hospital too ill for operative interference, and in a few weeks died. During the summer I had corresponded with her, urging her to return to the hospital, for it was clear from her letters that the fistulous communication between the gall-bladder and the duodenum was not working well. At the autopsy it was found that the carcinoma had recurred in the head of the pancreas and duodenum closing the common duct and interfering with the perfect action of the cholecystenterostomy, or cystico-enterostomy. The anastomosis, as we had supposed, had been made between the dilated cystic duct and the duodenum; the fistula was still perfectly pervious and should have acted nicely except for the interference, a little twisting or bending, created by the new growth.

The result in this case is not encouraging, for it was my opinion at the time of the operation that the case could not have been more favorable. But I did in this case what I never do if it can be avoided, namely, cut well down to or perhaps a little way into the new growth for the sake of diagnosis. It is furthermore a rule in my clinic that pieces shall not be excised from new growths *in vivo* for diagnostic purposes; we must learn to make the diagnosis in other ways. In the case of a very small breast tumor it is occasionally impossible to make the diagnosis before operation. I have sometimes approached the tumor with the knife very cautiously, and could tell before I reached the growth, from the findings in the outlying tissues, whether we had a malignant tumor to deal with or not. I shall have more to say about this at another time, but I feel that one cannot condemn too strongly the universal practice of exploring tumors with the knife or with the harpoon or even with the needle. After investigating the subject superficially, I have the impression that amputations for the truly malignant



sarcomata have comparatively seldom been successful when preliminary exploration has been done. If I find it necessary to make an incision into a sarcoma of an extremity, I first apply an Esmarch bandage, and if the tumor is a malignant growth, the bandage is not removed until the growth has been removed. So, too, in cysts of the breast; we should not aspirate them, because (1) they may be malignant and the aspiration harmful, and (2) if malignant, the aspiration does not tell us so. This is the first and I believe the only instance in which an operation for primary carcinoma of the duodenal papilla has been done; moreover, I know of no other case of excision of a portion of the common duct. Heidenhain\* (Worms) demonstrated last year at the twenty-seventh Congress of German Surgeons, a shriveled gall-bladder which he had removed for a small cancer of its wall; after extracting six calculi from the bladder, a little button-like prominence on its wall caught his eye. The microscopical examination showed little or no thickening of the mucous membrane, but unmistakable alveoli in the muscular wall of the gall-bladder; furthermore, some of the lymph-vessels were plugged with cancer cells. In three months the patient succumbed to liver-cancer which had attained great dimensions, although at the time of the operation the liver was apparently perfectly normal. At the same session Hollander† (Berlin) reported an extirpation of the gall-bladder and cystic duct and resection of a portion of the liver for cancer, which *per continuitatem* involved the liver. The result he could not give, for he had performed the operation only three weeks before. There can be little doubt as to the ultimate result of Hollander's operation, although, having operated only three weeks previous to his report, he could not give it.

CASE III.—*Dynamic or paralytic dilatation of first portion of duodenum and of the pyloric end of the stomach corresponding accurately to the limits of a sharply circumscribed peritonitis. Gall-stones in gall-bladder and cystic duct. Obstruction of cystic duct and hydrosis vesicae.*—Mrs. S. G. M., age forty six. Admitted January 31, 1899. Never had typhoid fever. Headaches at intervals all her life, sometimes very severe and lasting several days; especially severe during menstruation. Digestion has been bad for sixteen years. After meals a heavy feeling in epigastrium followed by fullness and a feeling of suffocation. Belching of gas common; occasionally would regurgitate a mouthful or two of food. Rarely vomited; never any blood in vomitus. Bowels generally constipated. Micturition frequent, occasionally twenty times a day; generally several times at night. Menses regular. Average weight, one hundred and fifteen pounds. Has lost in weight of late. Present illness, patient states, began December 31, 1898, although she was much run down before that time. This attack came on gradually. Some distention of stomach, and in the afternoon some pain which became severe at night. The pain was in the epigastrium—a colicky pain—which, as she expressed it “went through the abdomen.” Morphia exhibited. Next morning patient felt easier. Morphia continued for next two days. Pain relieved but not entirely subdued. Stools after this were very black, like tar. Physician found something in the stools which he thought might possibly be a gall-stone. Since this attack patient has never been well; constantly in bed. Great deal of soreness through abdomen, and at times attacks of colic. These

attacks usually came on in the evening without known cause. Much belching of gas. Bowels regular. Stools not clay-colored. No jaundice. Patient's daughter states that for many years her mother has had attacks of abdominal pain, for which the doctor gave morphia hypodermically. There were intervals of several months between the attacks.

*Examination.*—On palpation no tenderness except beneath the right costal margin. Here there is to be felt a rounded mass resembling a distended gall-bladder. Right rectus muscle very hard. The mass which is to be felt at the outer edge of this muscle seems lobulated.

January 29th. Attack of what patient calls “colic.” She is nervous and distressed, and complains of abdominal pain. Swallows air and belches it up again.

January 31st. Transferred to surgical side. On inspection a distended piece of gut between umbilicus and tumor, extending obliquely from the left and above to the right and below, probably six or eight inches in length. Peristalsis is to be observed at intervals; it is not very active, but at times is quite constant. A tumor suggesting gall-bladder projects from the lower border of the liver. It seems to be nodular, or rather has a nodule on it at its upper part. This tumor descends with respiration, and is somewhat tender. The edge of the liver can be felt on each side of the tumor.

February 3d. *Operation.*—Vertical incision through right rectus muscle. No fluid in abdomen. Gall-bladder distended to size shown in diagram on blackboard. Its walls were thickened and white. The first portion of the duodenum and the pyloric end of the stomach were distinctly distended. Corresponding accurately to the distended portion of the bowel was a slight peritonitis, scarcely more than an injection of the serosa, and an exudate, only enough to cause very fresh adhesions between the duodenum and the gall-bladder. We should hardly call them adhesions; the duodenum seemed rather to be lightly glued to the gall-bladder just as it might be an hour or two after an operation.

I was extremely interested to find that the vascular injection seemed to correspond accurately to the limits of the dilatation (almost ileus at times). The adhesions, if we choose to call them such, were so fresh that they were separated by very slight pressure of the finger. The general abdomen being walled off by gauze packing, the gall-bladder was opened. Its contents were colorless and in consistency like the white of an egg. Cover-slips were negative. First, one large gall-stone was found with a facet at each end. Then a second stone was detected with a probe in the cystic duct, but it could not be dislodged. Cysticotomy was performed and the stone removed in fragments. The previous attempts to dislodge it had evidently broken up the stone. Incision in cystic duct closed by mattress sutures. Gall-bladder treated in the usual way, namely, hermetically sealed about a rubber tube and protected by bismuth gauze, from the general peritoneal cavity. Abdominal wound closed in the usual way.

At first no bile escaped by the tube, but on the 10th of February, bile was abundant in the dressings.

March 2d. Wound has completely healed. Patient discharged cured.

Various diagnoses had been made in this case: (a) distended gall-bladder with adhesions; (b) cancer of bile-ducts and liver, involving secondarily the colon; (c) carcinoma of the colon, involving secondarily the gall-bladder and gall-ducts. The distended intestine I watched with much interest several times. It seemed to me too small for colon: and no mass could be felt in the distal side of the distended gut to explain the distention. Peritonitis is undoubtedly the most common cause of paralytic ileus, and I have repeatedly observed in appendicitis that dilatation of the cecum and of the ileum may

\* Heidenhain: Verhändl. d. deutsch. Ges. f. Chirurgie, 1898, p. 126.

† Hollander, l. c. p. 131.



be caused by a very slight, perhaps merely a toxic peritonitis, but I have never before noticed such a sharp line of demarcation between the inflamed and noninflamed portion of the intestine. The dilatation corresponded accurately to the vascular injection. This was the more striking because two portions of intestine so very different were involved. That the comparatively thin wall of the duodenum should be more or less affected by inflammation of its serosa is to be expected, but that such a thick-walled gut as the pylorus and the pyloric end of the stomach should be paralyzed by such a very slight inflammation of the serosa was surprising.

CASE IV.—*Conditions suggesting hepaticocolicostocholecystenterostomy as a possible operation. Common and cystic ducts reduced to fibrous cords, dilated hepatic duct and gall-bladder. Renal colic stimulating intestinal colic; relieved by salt infusion.*—Mr. —, age sixty, had been suffering from gall-stones for several years, but not until he became persistently icteric and very ill was the first operation performed. The operator, a distinguished surgeon, found most difficult conditions confronting him. The entire common duct was impervious and reduced to a fibrous cord; the cystic duct, greatly narrowed, was probably impervious; the gall-bladder and hepatic ducts were dilated. The surgeon, very skillfully, I am told, attempted to construct a new common duct over a tube or catheter from the tissue which he had at his disposal. Just what these available tissues were I do not quite understand. For about five weeks, and until this tube was removed and the surgeon went away on his vacation, the patient was fairly comfortable and seemed to be gaining a little. Then he developed high daily fever and occasional chills, and became jaundiced again. I saw the patient in consultation with Dr. Gardner, of Providence, about one week, I believe, after the fever and the symptoms of obstruction had manifested themselves. The gall-bladder could not be felt. There was perhaps a little more muscle resistance on the right side over the region of the bile-ducts than on the left side, also perhaps the suggestion, rather indefinite, of a little induration such as might be caused by fresh adhesions. It occurred to me that in case the gall-bladder and hepatic ducts were still both dilated one might establish a fistulous communication between them, making an hepaticocolicostostomy and then, immediately, a cholecystenterostomy; in all an hepaticocolicostocholecystenterostomy. In any event, we thought that an operation for the relief of the symptoms was imperative. Accordingly a vertical incision through the inner margin of the right rectus muscle was made, avoiding the fistulous tract which remained after the withdrawal of the tube over which the new common duct had been constructed. I worked for two hours trying to identify and to separate the parts concerned in this operation. The gall-bladder, the ducts and the duodenum were glued tightly together and to the under surface of the liver. The gall-bladder which was finally extricated from the tangle was very small, contracted and empty; the cystic duct was a fibrous cord. When bile was at last reached the patient was in such bad condition that the operation had to be discontinued. The parts in the neighborhood of the common and hepatic ducts were so firmly matted together that neither the latter nor the remains of the former had been demonstrated when it was necessary to bring the operation to a close.

The patient rallied satisfactorily from the immediate effects of the operation; but twelve or fourteen hours thereafter complained of very severe abdominal pain, which, as he indicated the location of it, seemed to be in the region of the colon and passing from right to left. The pain, though perhaps constant, became excessive during the paroxysms. It was never referred by the patient to his back or sides, nor did it radiate to the testicles or groin or crest or ilium. The abdomen was perfectly flat, and peristalsis could

not be observed. Nevertheless, large high enemata of hot water were given, but without appreciable relief. The urine was scanty and very dark and contained albumin and casts and a few blood-cells. Dr. Gardner promptly attributed the pains to the kidney, and related a somewhat similar case. Believing his interpretation of the pains to be correct and recognizing the fact that something must be done quickly for the relief of the kidneys, I transfused about 750 cc. under the breasts. The pulse, which was alarmingly rapid before the transfusion, dropped 40 beats within thirty minutes, and 20 beats within five minutes, and the colicky abdominal pains disappeared. Within twenty-four hours the infusion was repeated with similar results. The kidneys responded promptly to both infusions.

I report this case because (1) it suggested a new operation, hepaticocolicostocholecystenterostomy, or hepaticocolicostostenterostomy; (2) it was the first of three cases of colic which I have seen associated with scanty high-colored urine; and (3) it was, so far as I know, the first instance of subcutaneous infusion of salt solution for the relief of toxic renal colic. Soon after this Dr. Young, by salt infusions, undoubtedly saved the life of one of my patients whom I had operated upon for appendicitis, and who was suffering from perhaps the most furiously rapid toxemia that I have ever known of. This case has been reported by Dr. Young in the *Maryland Medical Journal*. The resemblance to intestinal colic is so great that it would undoubtedly be mistaken for it even by experienced practitioners of medicine. This was a valuable lesson for me, for since then I have twice recognized as renal colic this pain, which had been regarded as intestinal colic and treated with high injections. Our list of desperate cases of toxemia treated advantageously with infusions of salt solution is assuming large proportions.

CASE V.—*Cholelithotomy performed twice within four and one-half months. The gall-bladder, small and contracted at the first operation, when two stones were in the common duct, was large and distended when only one stone occupied the common duct (the ampulla).*—Mrs. M. P. R., age fifty-eight, admitted May 3, 1897. October, 1892, patient began to have moderately severe attacks of pain in the region of the gall-bladder. The attacks would come on suddenly and last several hours unless relieved by anodynes. The pain, milder at first, would gradually increase until it became very severe; it commenced in the epigastrium and extended into the right hypochondrium. During the winter of 1892-1893 the attacks occurred every two or three days. Occasionally there would be an interval of two or three weeks. During the remainder of 1893 and all of 1894, the attacks persisted at longer or shorter intervals, the pain always beginning in the epigastrium and radiating to the back. Sometimes during a severe attack there would be slight vomiting. Morphia generally gave relief. Patient says that the attacks were not accompanied by tenderness nor tumefaction. In the attacks observed by me there was always tenderness and, after the first operation, distention of the gall-bladder. In the spring of 1895, she went to Hot Springs, Va., where she remained several months. After this she had no pain for fifteen months, but did not seem to gain or improve in health. In September, 1896, in Italy, the pain returned. The attacks recurred with great regularity for seven or eight weeks. Most of them were attended by nausea and some by vomiting. She became jaundiced for the first time in December, 1896, and has remained more or less icteric until admission. Just after the paroxysms the icteric is deeper. For the past five months she had remained in bed most of the time. She vomits frequently, is seldom free from nausea. The bowels

have not been markedly constipated; appetite is poor; headaches occasional but not severe. Prior to this illness, however, she suffered very much from headaches. At no time has she had chills or sweating.

*Examination.*—Patient is quite deeply jaundiced; her color is a dark slate-yellow; tongue heavily coated; body much emaciated; expression rather dull, eyes lusterless. Heart not enlarged; no adventitious sounds. Lungs negative. Urine dark, almost coffee-colored, trace of albumin, much bile-stained sediment. A few bile-stained casts and epithelial cells. Red blood-corpuscles, 4,220,000; white, 6,000.

May 4, 1897. *First operation.*—Longitudinal incision through right rectus muscle; resection of cartilages of eighth, ninth and tenth ribs, because the common bile-duct was very inaccessible. Cholecystotomy; removal of one small mulberry calculus. Exploration of duct fails to detect a second stone. Suture of duct wound. Gall-bladder atrophied and not opened. Bismuth gauze packing to suture in duct. Peritoneum sutured with fine silk, muscles and fascia with silver wire, and skin with a buried suture of catgut. Little or no shock from the operation.

On opening the abdomen the tissues were bile-stained. There was no fluid in the peritoneal cavity. The outer surface of the contracted gall-bladder was covered with new connective tissue in which were little masses of fat. The omentum was loosely adherent to the gall-bladder. The cystic and common ducts were easily isolated after division of three of the costal cartilages. No stones could be felt in the bladder or cystic duct. The stone found in the common duct could be moved quite freely up and down in this duct, but could be forced into the cystic duct, the common duct, about 1½ cm. in diameter, being uniformly dilated. Bile flowed from it when opened. It was carefully explored with the fingers but not with an instrument. The gall-bladder was not opened. Two mattress sutures closed the opening in the duct, one preliminary suture being taken before the duct was opened. The sutures were passed without difficulty, the wall of the duct being about 3 mm. in thickness. No leakage occurred after the stitches were tied. The calculus, without facets, was spherical, about 1.6 cm. in diameter, and had a granular surface like a mulberry calculus.

May 15th. Patient has recovered uneventfully from the operation. She is easily nauseated, however, and has very little desire for food. The stools have about the color of dark coffee and the skin has become lightened perceptibly. She complains, however, of an aching pain in the back, not relieved by posture.

May 24th. Patient has no inclination to eat; takes almost nothing by mouth. Nutritive enemata, which have been administered uninterruptedly since the operation, are still well borne. About every two days there is quite a definite attack of pain in the umbilical region and back, ushered in by nausea. Vomiting usually follows in a few hours and the distress is relieved.

May 29th. Condition little changed. Patient is fairly comfortable except for the attacks. Takes a little more food. Stools semi-solid and still quite dark. Urine has trace of bile.

June 13th. No bile in urine. Vomitus contains considerable hydrochloric acid.

June 26th. Appetite and digestion have steadily improved. Nausea less constant, often absent. Patient constipated, requires enemata; stools normal as to color.

July 4th. Much more comfortable. Nausea has disappeared; color greatly improved, but the attacks of pain continue, although they are less frequent.

July 13th. Slight chill at 5.30 p. m., accompanied by pain in the back and head. Temperature reached 103° at 7.30 p. m.; fell to 99.2° at 5 a. m. Examination of blood for malaria, negative.

July 25th. Patient has lost one and one-half pounds in weight in the past week. The right lobe of the liver is enlarging. The spleen is palpable. Patient is having short attacks of fever accompanied by slight chills; headache and yawning usually associated

with them. The attacks of pain continue; they are still controlled by very small doses of morphia, one-sixtieth to one-fortieth of a grain. She sits up out of bed most of the time.

July 27th. The pain in the back has of late been accompanied by a slight rise of temperature, 99.2° to 105.5°. The urine contains no bile. The stools consist of light and dark portions sharply separated. Patient is gaining quite rapidly in weight.

August 5th. Stools clay-colored. Temperature reached 102° last night during an attack of pain. Skin is becoming icteric; urine contains bile; slight pruritus. Patient's weight has increased five pounds in ten days. From August 8th to 12th no bile in urine.

Sept. 12th. The attacks of pain and the pyrexia continue. Patient is decidedly icteric after some of the more severe attacks. What we have feared ever since the operation we are now quite certain of, namely, that there is still a stone in the common duct, probably in Vater's diverticulum. The liver is considerably enlarged, but the gall-bladder has not been definitely made out.

September 13th. *Second Operation.*—Vertical incision near linea alba. Adhesions from previous operation separated without much difficulty. Liver much enlarged; gall-bladder and common duct distended with bile. The wall of the common duct was much thicker; the wall of the gall-bladder, on the other hand, was probably thinner than at the previous operation. A small stone was palpated deep down behind the duodenum, presumably in the ampulla. The line of the old suture in the ductus choledochus could not be very definitely made out, but a short yellowish-white streak, evidently cicatricial tissue, corresponded, I thought, to the site of the original slit in the duct. A fine suture was placed in the common duct to serve as a handle for the subsequent manipulations. The duct was opened, and about 60 cc. of clear greenish bile escaped. A gauze plug was inserted into the proximal end of the slit to prevent the stone from slipping into the hepatic duct. Interrupted sutures were taken over a hammer of the proper size. The dislodgment of the stone was somewhat difficult. It was a little smaller than the first stone, but otherwise repeated the original exactly. The gall-bladder was opened, sewed to the peritoneum, and drained in the usual way; a rubber tube surrounded first by gauze and then by protective being held in place by a purse-string suture of catgut. Wicks of bismuth gauze protected the line of suture in the common duct. The operation was attended with very little shock and the patient reacted very well.

Sept. 20th. There has been more or less nausea ever since the operation. Patient objects decidedly to stomach washing. Bile is draining actively from the tube. There has been little or no nausea to-day, but patient is weak and much depressed. The removal of a piece of gauze from the gall-bladder gives patient the first sensation of "heartburn," which she has had since the operation; it lasted several hours.

Sept. 22d. Patient is thin and emaciated and alarmingly weak; speaking is a great exertion to her. Temperature subnormal. There are no wound complications, nor any signs of peritoneal irritation or obstruction. Alimentation is almost exclusively rectal; 6 p. m. vomited 1000 cc. of fluid thick with "coffee grounds." Patient very restless. Examination of vomitus: No bile; blood-corpuscles abundant; altered blood pigment; free hydrochloric acid; no lactic acid.

Sept. 23d. Patient has vomited several times during the day; in all about 2000 cc. of the same dark coffee ground vomitus. The pulse is very feeble.

Sept. 24th, 8 a. m. Pulse barely susceptible early this morning; rallied a little after exhibition of salt solution per rectum. Still vomiting large amounts of same fluid, though nothing is being administered by mouth. 12 m. Patient is very low but still conscious. Infusions of salt solution were given under breast and in buttocks. 5.15 p. m. One drachm of one per cent. solution cocaine given by mouth. 5.30 p. m. Patient vomited 360 cc. of same dark fluid. Cocaine given again. No vomiting since second dose.



Sept. 25th, 1 A. M. Patient responds a little to the saline infusions. She is moaning and restless. Her nose and extremities are cold. She sleeps in short naps, with her eyes open and eyeballs rolled up. Complains greatly of thirst. Champagne and albumin retained and apparently relished.

Sept. 28th. Infusion again soon after midnight. Involuntary stools and small amount of dark vomitus. Is somewhat flighty at times. Pulse is thready, irregular, and cannot be accurately counted. She is sighing and seems almost moribund. Too weak to recognize surroundings or members of the family. About noon to-day I saw the patient for the first time since the third day after the operation, having returned to town as rapidly as possible in response to a telegram sent forty-eight hours ago. Dr. Cushing, house surgeon, who had attended her constantly, day and night, met me at the door of the hospital with the words, "no hope, she is dying." We went to her room; she was cold and almost unconscious; her eyes were open, the eyeballs rolled up; the lower jaw had dropped. She had had more involuntary movements and could retain no nourishment. Her pulse was little better than a flutter and could not be counted. In less than forty-five minutes I returned to the patient and found her pulse 120, and fairly regular in force and rhythm. I doubted my senses when I counted it. She was moreover not so cold, her eyes were not staring, and her lower jaw was raised. A miracle! From that moment her convalescence was uninterrupted. She slept an hour, and on waking looked better than she had in two or three days. For twenty-four hours she was so weak that she could barely move her arms. She remembers nothing that transpired on the 23d, 24th and 25th of September.

In eight weeks, on November 22d, this patient left the hospital, not only able to walk but to take a long journey on the railroad. In one period of seven days she gained nine pounds. Her liver was rapidly diminishing in size.

In April, 1898, I had the pleasure of seeing this patient again. Her color was natural, her digestion excellent, her weight above normal and her strength steadily increasing. Her liver did not extend below the costal margin.

I have seen many cases regarded as hopeless recover, but never a being so near death as this have I known to escape it. I have speculated much as to the possible explanation of the very sudden change in her favor, but it would lead us beyond the limits of this paper to discuss the matter. In toxemias I have noted almost instantaneous drops in the pulse rate. Twice within a month I have observed a fall of 30 beats to the minute follow in less than thirty seconds the opening of an abscess. The abscesses were large and very acute; one was a suppurating laparotomy wound and the other was a circumscribed abscess in the peritoneal cavity. The very instant that the abscesses were opened the change in the pulse was noted. A few months ago we were preparing to infuse with salt solution a patient upon whom I had operated for gall-stones and whose condition gave me not a little anxiety. His respirations were about 40 per minute and his pulse between 130 and 140. The physical signs indicated not very clearly some consolidation of the lower lobe of the right lung. While the instruments were being sterilized for the infusion, and while Dr. Cushing, the house surgeon, was counting the pulse, it fell to less than 100.

Was the hemorrhage from the stomach in the case of Mrs. R. (Case V) due simply to the prolonged vomiting; or to interference with the circulation of the portal vein (liver cirrhosis, pressure of packing); or to thrombosis of a small arterial branch:

or to a retrograde embolism (Recklinghausen,\* von Eiselsberg†) or malposition of the pylorus or duodenum? It could hardly have been due to sepsis for there were no signs of infection. As long ago as 1867, Billroth‡ remarked that in septic cases we might have duodenal ulcers and fatal hemorrhages therefrom. He showed in his experiments upon animals that sepsis might cause intestinal hemorrhage, although, in his experience, it seldom did so in man; if, however, there existed an obstruction to the circulation, such as liver cirrhosis causes, little hemorrhages in the stomach plus the action of the gastric juices might lead to the formation of ulcers. The nausea began almost immediately after the operation. Whatever was the cause of this almost continuous nausea and frequent vomiting was also, probably, at least the remote cause of the hemorrhage. Von Eiselsberg has just reported seven cases of stomach and duodenal hemorrhage following operations upon the abdomen. Hematemesis occurred in six of his cases, and never later than the second, usually on the first day. The hemorrhages were demonstrated in three cases post mortem.

In my case the vomiting of "coffee grounds" was not observed until the tenth day. This patient was so carefully watched that I am quite sure that if hematemesis had occurred earlier it would not have been overlooked. In seeking for a common cause for the stomach and duodenal hemorrhages, Von Eiselsberg excludes vomiting because in two cases there was no vomiting, and in two, hematemesis occurred only a single time; he also excludes sepsis because in four of the cases there was no infection, and reaches the conclusion that "If the behavior of the wound is to be regarded as the cause of the hematemesis, then it must be assumed that in the cases which healed by first intention a retrograde embolism from a non-infected thrombus had taken place."

I wish that there was time to discuss this feature of the case more fully, but I must pass on to the consideration of another fact which this remarkable case developed. There were at the first operation almost certainly two stones in the common duct, one in the ampulla, the other more or less freely movable in the duct, although it fitted it quite snugly; but the gall-bladder was small and contracted and not opened, and the liver was little if at all enlarged; the color of the skin was a light slate-yellow or ash-yellow—not the darker bronze-yellow of complete obstruction. At the second operation, however, when there was only one stone in the common duct, the gall-bladder was distended with bile and quite large, and the liver was greatly enlarged, its right lobe almost reaching the crest of the ilium. The patient's color and symptoms indicated that the stone in the ampulla did not at all times obstruct the duct completely. It sounds almost paradoxical to say that the removal of a stone should increase the obstruction, or that the one stone plugged the duct more completely than the two. I believe that a stone in the diverticulum, particularly a small

\* Die Störungen des Blutkreislaufes.

† Die Verhandlungen der deutschen Gesellschaft für Chirurgie, 1899.

‡ Ueber Duodenalgeschwüre bei Septicaemia. Wiener med. Wochenschr., 1867.



one, is more likely to block the duct effectually and to lead to distention of the gall-bladder than a stone, however large it may be, elsewhere in the common duct. A stone in the middle of the duct may at first occlude it completely, but the duct wall soon becomes infiltrated and thickened, it loses its elasticity, and, when distended with bile, stretches. The stone no longer plugs the duct tightly and bile trickles by into the intestine even when a second stone occupies the diverticulum, but when the proximal stone is removed, the bile instead of trickling up to the distal stone is probably jetted against it with sufficient force to hold it as a ball-valve. Furthermore, dilatation should not occur so readily in the portion of the common duct protected by the duodenal wall as in the free portion. In 1885 I operated upon a patient whose common duct contained a stone larger than the largest pecan-nut; at times one half of this stone projected into the duodenum, the other half occupied the duct; a flange had been cut on the calculus by the cicatricial ring, which engaged it and prevented it from slipping into the intestine; and yet this patient was so very slightly jaundiced that a stone in the common duct had not been suspected.

**CASE VI.** Miss M. H., age thirty. Transferred to surgical from medical side, January 27, 1896. Indigestion for eight years. For past four years the "gastric distress" has been very great. Patient describes a "gnawing sensation" in the epigastrium. Colicky pains radiated throughout thorax, but were at times very severe "in the back." Two years ago she had typhoid fever. For the past six months she has had frequent definite sharp gall-stone attacks with nausea, and four times with vomiting. Never blood in the vomitus. No chills, fever nor jaundice. Patient is a confirmed invalid. She suffers from headache and occasionally from vertigo.

**Examination.**—Abdomen flat. On deep inspiration spheroidal tumor is to be seen just below the costal margin on the right side. This tumor can also be felt. It moves with the enlarged liver, ascending and descending with the respirations. Last September patient first began to have attacks of pain in right hypogastrium, and accompanied by nausea and sometimes by vomiting. Spleen not palpable. The severe pain suffered by patient could be relieved by drawing up the knees. This pain radiated to the right shoulder-blade.

January 28, 1896. **Operation.**—Cholecystostomy. Vertical incision through the right rectus muscle. Elongated right lobe of liver. Very dense fibrous adhesions between the gall-bladder and duodenum. These adhesions were divided with great difficulty, and finally what appeared to be gall-bladder presented. It was aspirated, and a thick greenish fluid withdrawn. It was consequently opened with some confidence, but proved to be duodenum. It was sutured again at once, the suturing being very difficult because the muscular coat had been separated from the submucous coat during the dissection of the adhesions. The muscular coat, owing to the chronic inflammation which had existed for so many years, had become sufficiently fibrous to resemble cicatricial tissue, and consequently was unintentionally stripped from the submucosa. When the submucosa presented, it did so in the form of a little knob-like bladder, this coat resembling almost precisely the wall of the gall-bladder. The gall-bladder was finally found, deeply imbedded in adhesions, almost four cm. to the right of its usual position and far under the enlarged liver. It was opened, and one large oval stone, two cm. by one cm., removed. In the course of the operation a small abscess was discovered in the midst of the adhesions. Patient's recovery was considerably retarded by digestion disturbances, which finally disappeared completely.

April, 1899. Patient says that she is in robust health and wishes to become a masseuse.

**CASE VII.** The history of this case cannot be published at present.

**CASE VIII.** *Discharge of pus and blood by mouth and rectum during severe gall-stone attack. Two years later adhesions so extensive and so dense that the common duct was reached by a retroperitoneal route, over the right kidney.*—Mrs. M., age thirty-five. Admitted March, 1895. No typhoid fever. First attack of gall-stones, six years ago, began with sharp attack of pain in the right side of the abdomen. Two years ago miscarriage at seventh month; was ill in bed thereafter four months. While in bed patient had great pain in region of gall-bladder, with high fever, for ten weeks; was continually blistered over liver. Eight weeks after the abortion she felt suddenly something "give way"; this giving way was followed by great relief, and by horribly offensive discharge of pus and blood from the rectum and mouth. These discharges were irritating, gave her a very sore throat and mouth. She spat blood and matter for two or three weeks, and the stools during this time were very offensive. She has had pain and tenderness constantly, with occasionally severe attacks since that time; has been jaundiced more or less ever since, but more markedly so since last July. On admission, body jaundiced and greatly emaciated; tenderness over the entire abdomen, especially in the region of the gall-bladder. Liver, in deep inspirations, extends two fingers' breadth below costal margin, and has a fairly sharp edge. Spleen palpable; stools acholic.

March 19, 1895.—**Operation.** Liver small, barely reaches costal margin; its high position complicated the operation. Colon adherent to liver by rather loose bands; gall-bladder exposed when these were divided. It was high up under the liver and no larger than the tip of the little finger; it was not opened. Adhesions were so dense over the common duct that the peritoneum was opened over the right kidney, and the common duct approached from behind under the peritoneum. A stone being felt, the common duct was the more readily exposed; the stone was extracted through a hole made by ulceration. This hole proved to be at the junction of the duct and the duodenum, and was shut off from the peritoneal cavity by very delicate adhesions. The intestinal part of the opening was closed completely, the duct part as well as possible. The sutures were passed with great difficulty. The opening in the duct could not be completely closed, the tissues being necrotic, and bile escaped through it even after the sutures were drawn tight. Probing of the duct was carefully done. No other stones were found.

October, 1895. Six months after operation, patient is very well, She weighs one hundred pounds.

April, 1899. Examined in my private office: patient still enjoys perfect health; she now weighs one hundred and ninety pounds. Patient states that she has recently given birth to a healthy child.

I report the case of this woman because (1) she was so very ill when operated upon; (2) it is one of the two cases in which intestinal perforation had undoubtedly occurred prior to operation; (3) the common duct was approached in a new way, namely, from behind the peritoneum; (4) the stone, in the ampulla, had ulcerated through the walls of the ductus choledochus and the duodenum, and would perhaps soon have been extruded; (5) the increase in the weight of the patient seemed phenomenal; it was almost doubled within the year following the operation.

What the result to the patient would have been if this stone had ulcerated its way out of the common duct is quite certain, and yet I have several times found stones imbedded in adhe-

sions outside of the bile passages; they were usually close to the gall-bladder. Once I discovered a stone in the wall of a thick-walled gall-bladder; it was completely buried and was causing no disturbance, and was detected in the process of sewing in the drainage tube. This is, I believe, the only case in which I have not divided all of the adhesions encountered. If no contraindication exists, such as necessity for abbreviating

the operation, we should separate the adhesions if possible. The chance of meeting fistulous openings between bile passages and the intestine I regard as an indication for thorough exploration rather than a contraindication to it. Not infrequently adhesions alone are responsible for the symptoms which persist after the calculi have been removed by the surgeon or have escaped in other ways.

## EARLY EXPLORATORY OPERATIONS IN TUBERCULOSIS OF THE HIP.\*

### A PRELIMINARY REPORT.

(From the Clinic of Prof. Halsted, The Johns Hopkins Hospital).

By JOSEPH C. BLOODGOOD, M. D., Associate in Surgery.

I wish to report a case of early operation in tuberculosis of the hip, and am sorry the patient is not here to demonstrate the very happy result.

**CASE I.**—*Tuberculosis of left hip, of seven weeks' duration. Operation: Capsule distended; tubercular synovitis; small tubercular focus in the neck of the femur. Result, January, 1899 (13 months), perfect. No restriction of motion.*

M. K. Surg. No. 8380. Male, æt. 42 years, butcher by trade, was first admitted to the hospital October 6, 1893, 5 years ago, suffering from tubercular arthritis of the left shoulder joint. The disease of the soft parts and bone was extensive; for this reason excision was performed at once. Although 3 cm. of the shaft of the humerus were removed, the functional use of the arm is an excellent one.

It is of interest to note the possible etiology of the arthritis of the shoulder. This man had always been in excellent health. He could remember no cases of tuberculosis in his family. Eight months ago, he cut his left wrist with a dirty butcher-knife. The wound healed in about one week. One month later he noticed pain in the left shoulder, which was followed by a slight stiffness. The condition was treated for rheumatism. Five weeks ago he noticed a swelling of the upper third of the arm to the inner (medial) side of the biceps muscle.

The patient was readmitted November 30, 1898 (5 years later), complaining of pain and stiffness of the left hip joint. The following are the important facts in the history:

About seven weeks before admission, without any recollection of a traumatism, he experienced, when getting out of bed one morning, pain in the left hip. This pain has been increasing, and is now and then referred to the knee. During the last two weeks the joint has become almost immovable. He has been able to walk some, although it gives him a good deal of pain. He limped into the hospital.

**Examination.**—When the patient lies flat on his back with both legs extended, the anterior superior iliac spines appear to be on a level. There is very slight apparent shortening of the

left leg. This, however, is due to real shortening between the trochanter and external malleolus. There is no shortening between the iliac spine and great trochanter. The hip is fixed at about 25°. There is no apparent abduction or adduction. Any attempt at motion at the hip joint gives pain, and with each motion the pelvis moves with the limb. There is no swelling about the hip joint except on the anterior surface of the thigh. This swelling is situated below the outer two-thirds of Poupert's ligament, to the outer side of the vessels and extends downwards a distance of about 4 cm. It is most prominent 2 cm. within the line of the tensor vaginæ femoris and 2 cm. below the iliac spine. The swelling is not very painful and on palpation seems to fluctuate. When the patient is quiet in bed and does not attempt to move the limb he suffers no pain. The leg is only painful when he attempts to walk or when some one attempts to bend it at the hip joint. The examination of the lungs was negative. The general health of the patient appears to be excellent. The patient remained under observation from November 30th to December 8th. On December 2nd, following an injection of 2 milligrams of tuberculin, the temperature rose to 100.5°. On December 4th, following 4 milligrams of tuberculin, the temperature rose to 100°. With these two exceptions, a two-hour chart shows a registration of rectal temperature between 98.5° and 99.5°. Following the injections of tuberculin the patient complained of no discomfort whatever. The only fact to be noted was that shown in the slight fever. The leucocyte count before operation was 4,000.

The arthritis was considered to be, without much doubt, tubercular, and the swelling on the anterior surface of the thigh to be due to distention of the capsule of the hip joint which had not yet ruptured.

**Operation.**—December 8, 1898. Anæsthetic, ether. When the patient was fully narcotized, it was demonstrated that with the exception of flexion there was but little restriction of motion in the hip joint. An incision was made in the anterior surface of the thigh, beginning at the anterior iliac spine, and the capsule of the hip joint was exposed by separating the tensor vaginæ femoris on the outer side from the rectus muscle on the medial side. As soon as the muscles were separated a tense swelling was found, which upon its surface was smooth

\* Read before the Johns Hopkins Hospital Medical Society, May 8th, 1899.

and white in color. Upon its outer surface there was no exudate, nor was it adherent by connective tissue to any of the surrounding structures. When incised, it was found to be from 3 to 4 mm. in thickness, of firm white tissue, and proved to be the distended capsule of the joint. The cavity contained a large amount of viscid serous fluid containing numerous flakes of lymph and some necrotic material. The inner surface of the capsule of the joint presented the ordinary picture of tubercular synovitis. Here and there one saw cedematous hemorrhagic granulation tissue, in which were areas of yellow necrotic tissue, which could be easily scraped from its fibrous base. Between these areas of granulation tissue were smooth areas paler in color. On retracting the muscles more widely and enlarging the opening in the capsule, the head and neck of the femur were easily exposed. The examining finger at once found a small cavity on the inferior and slightly anterior surface of the neck, near its junction with the head of the bone, which about admitted the index finger (Fig. 1 *a*). One could also see the cavity, and in its



CASE I. FIG. 1. *a*. Focus of tubercular osteomyelitis. *b*. Area of bone removed.

center was a small area of yellow necrotic tissue. The bone lining the cavity was slightly hemorrhagic, but when cut with the chisel was found not to be very soft. About 3 to 4 mm. of bone about the cavity were removed with the chisel (Fig. 1 *b*.) Beyond this, the cancellous bone appeared to be normal. The head of the femur was easily seen. The cartilage was not eroded. The cartilage lining the cotyloid cavity could be seen only at the rim about the head. It also appeared to be normal. The trochanter and shaft of the femur were exposed. The periosteum was not thickened. The entire surface of the capsule of

the joint was curetted. The bone cavity in the neck, and the surface of the synovial membrane after curetting were swabbed with pure carbolic. The wound was then thoroughly irrigated with 1 to 1000 bichloride, followed with salt solution. After mixing iodoform powder with the blood clot, the wound was closed, leaving a small drain extending into the capsule but not into the cavity in the bone. The entire limb and pelvis were fixed in a fully extended and slightly abducted position in plaster.

*Notes after Operation.*—The patient was perfectly comfortable and at no time during the convalescence experienced pain in the wound. The night after operation the temperature rose to 103.2°, falling to normal in the morning. On the second evening it rose to 104°; on the third to 103°; and on the fourth to 102°, falling to normal each morning. With this rise of temperature there was very little change in the pulse. The leucocyte count varied from 2700 to 4000. Nothing was found to explain the fever. Culture and cover-slips from the serum in the wound were sterile. From December 12th to January 28th the temperature chart records no fever. The drain was removed on the sixteenth day. For four weeks the sinus communicating with the joint was irrigated daily with 1 to 1000 bichloride and injected with an emulsion of iodoformized oil. The wound at no time showed any evidence of infection and was completely closed at the end of five weeks. The patient was kept in bed in extension for six weeks, and then allowed to get up in plaster.

*Note, August 14, 1899.* The patient returns to the hospital walking without crutches or cane. It is eight months since the operation and six months since the plaster cast was removed. For five months the patient has been able to return to his work as a butcher. He has had no further pain. The wound is healed solidly. Careful measurements show no difference in the length of the bone or between the anterior iliac spine and trochanter, except the one noted before operation of 1 cm. shortening between the trochanter and external malleolus. Motions in the left hip joint are possible in every direction, and are but very little restricted in each (see Figs. 2, 3, 4). Forced motions are painless. Previous to operation the left leg was flexed to 25 degrees; it now can be fully extended without change in the pelvis.

*Examination.*—January 10, 1900. The patient's condition is the same as that noted in August. The result so far appears to be a perfect one, not only with every evidence of an eradication of the disease, but with complete function of the joint. (See Case IX for operation in the right hip.)

CASE II.—*Tuberculosis of right hip, of seven years' duration. Operation: Firm fibrous ankylosis; no evidence of bone or joint tuberculosis; incapsulated extra-articular tubercular abscess. Result, Jan. 1900, 9 months, excellent.*

*Surg. No. 3540.* There is at present (May, 1899) in the wards, a young girl who was admitted to the hospital November, 1, 1894. At that time she was suffering with tuberculosis of the right hip, the onset of which had been two years previous, when she was eleven years of age; that is, seven years ago.

*Examination.*—November 5, 1894, under ether. No apparent shortening. The right (affected) limb is flexed to 45 degrees,





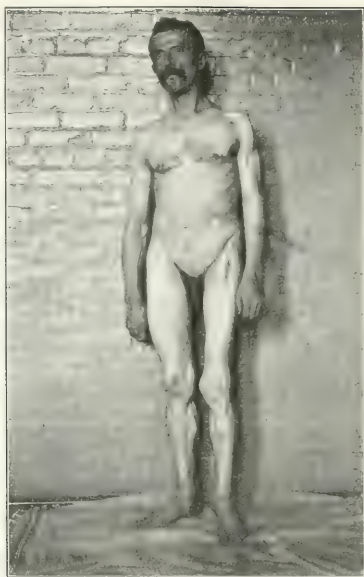


FIG. 2.—Result in Case I, eight months after operation.



FIG. 3. Limit of abduction, Case I.

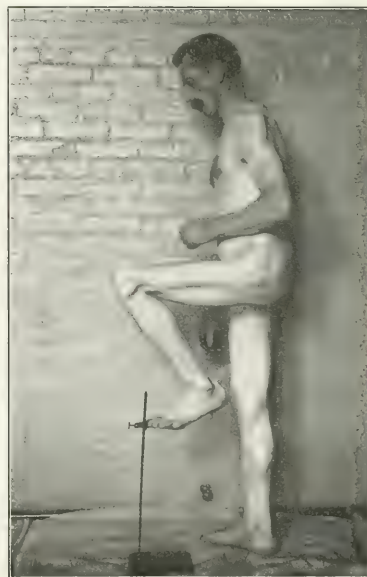


FIG. 4. Limit of flexion, Case I.

slightly abducted and slightly rotated out. Apparently no real shortening between anterior iliac spine and trochanter or trochanter and external malleolus. The measured shortening between anterior iliac spine and internal malleolus 1 cm. (due to abduction).

*Examination.*—April 25, 1895, after seven months. The flexion is less 20 degrees. Apparent shortening 1 cm., due to tilting up of the pelvis. Measured shortening between iliac spine and external malleolus 2.5 cm. Real shortening between iliac spine and trochanter perhaps 1 cm. Patient is very fat, and these measurements are difficult to make. The leg is still slightly abducted. Rotation out less.

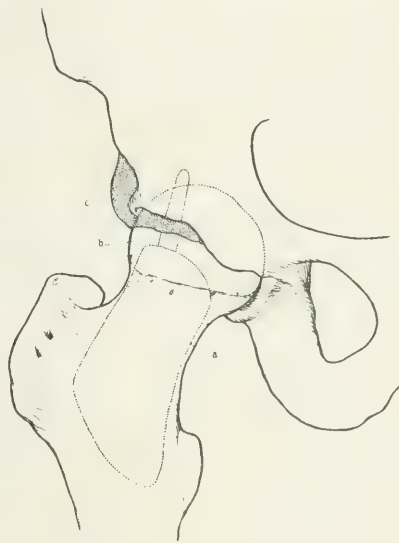
*Examination.*—December 8, 1896, after two years. Apparent shortening 3 cm. Real shortening between anterior iliac spine and trochanter 1 to 1.5 cm.; between trochanter and external malleolus 2.5 cm. (about equally distributed between thigh and leg). These measurements demonstrate that within the last two years, under the best orthopedic treatment, a centimeter of real shortening has taken place, and there has been a lack of growth in the shaft of the femur of 2.5 cm.

*Examination.*—April, 1898. Very little if any change.

From November, 1894, up to the present time, a period of almost five years, she has been under treatment. After her first admission to the hospital she remained in the wards for two years. The treatment consisted of iodoform injections, and later of fixation in plaster. During this time her general health has remained about the same. There has been little or no loss of flesh, no fever, and no evidence of tuberculosis elsewhere. On December 6, 1896, she was given tuberculin, which was followed by no evidence of reaction. Four weeks later an abscess formed below the great trochanter. It was opened, and healed rapidly. In October, 1897, there was slight reaction to tuberculin. About four weeks ago she returned to the hospital for inspection. She was still using crutches, and suffered a good deal of pain in the hip, not only during the day when she was sitting in a chair or walking on her crutches, but also at night. This pain was generally relieved by extension.

*Operation.*—April 20, 1899. Ether. Under the anæsthetic it was found that the hip joint was almost completely fixed in a flexed and very slightly abducted position, with no rotation. An incision similar to that employed in the first case was made. On dividing the fascia lata about 5 cm. below the anterior iliac spine, a small cavity (2 cm. in diameter) was opened. In the center of the cavity was a mass of yellow necrotic material and a little clear serous fluid. The wall of the cavity was of smooth white fibrous tissue. No granulation tissue could be found. This cavity corresponded in position to the abscess which formed and healed a year and a half ago. It was completely excised and no communication between it and the bone or joint could be demonstrated. (A very small healed sinus, however, might have been overlooked). On exposing the joint, the head and neck and trochanter of the femur were covered with dense connective tissue. This was excised, exposing the periosteum over the trochanter and upper part of the shaft. The periosteum was slightly thickened, and on stripping it back the bone was a little rough. The outer layers of the bone of the shaft and trochanter were very thin, also that of the neck. The anterior surface of the neck, troch-

anter and shaft was removed with a chisel (Fig. 5 *a*). The cancellous bone was very soft and hemorrhagic; the marrow was also fatty and very hemorrhagic. The head of the bone and the acetabular cavity were covered with scar tissue, in which no granulation tissue could be found. Over a small portion of the head of the bone which was exposed there was normal cartilage. No disease of the pelvic bones about the acetabular cavity could be demonstrated. About the acetabular cavity there was a narrow ridge of new bone (Fig. 5 *c*). The wound was thoroughly irrigated, and the small bone cavity made during the exploration was allowed to fill with blood clot mixed with iodoform, and the wound closed without drainage.



CASE II. FIG. 5.—*a*. Area of outer table removed to expose neck, epiphysal line and head. *b*. Gouge groove to explore acetabulum through head. *c*. New bone about rim of acetabulum.

At the operation, although the junction of the neck and the shaft was exposed, it was difficult to tell whether the angle between the neck and the shaft were more or less than normal. The neck, however appeared to be shorter than normal. Following the operation, the patient had no discomfort and the wound healed perfectly. She was discharged September 15, 1899, wearing a splint and using crutches. This supporting apparatus was used because I feared that following the removal of the bone, the neck of the femur might possibly have been weakened, and that to allow the patient to walk without some support might be followed by bending of the neck with its resultant deformity. While in the hospital, especially after the patient was up and about on crutches, the pain complained of before operation was not present.

*Examination.*—January 19, 1900. The patient has no pain. She walks much better but still uses the crutches and wears



the splint. No change in measurement. Advised to discontinue crutches and later the splint.

I have reported these cases to the Society to illustrate the happy result, in the first case, after an early operation. Here, seven weeks after the beginning of the disease, we found a greatly distended capsule filled with necrotic material and lined by tubercular granulation tissue and a tubercular focus in the neck of the femur. Following the partial removal of the disease of the soft parts and the apparent complete removal of the disease of the bone, we have every evidence of the complete cure of the disease, and three months after operation the patient is able to resume his occupation as a butcher, and the functional use of the joint is almost perfect.

In the second case, after seven years of conscientious orthopedic treatment, the patient is practically in the same condition. The exploratory operation, however, demonstrated that the disease was to all appearances cured. In this latter case an earlier exploratory operation, if it had demonstrated the same condition, would have relieved the patient of a number of years of enforced rest, or, if the disease had been present, would have allowed its earlier eradication.

#### ADDITIONAL CASES.

*Note, January, 1900.*—Since the above report was made, twelve cases of tuberculosis of the hip have been subjected to operation. Nine are here reported—three cases of very recent date not being included in this report. In all, the immediate results have been very encouraging.

*CASE III.—Tuberculosis of left hip, of 15 months' duration. No relief of symptoms after two and a half months' treatment with extension in bed. Operation: Distention of capsule; erosion of head and neck; no bone foci found; immediate relief of symptoms. Result January 1, 1899, six months, excellent.*

G. L. H. Surgical No. 8874. Male, *æt.* 10. Was admitted April 19, 1899, complaining of pain in the left leg. His father died of tuberculosis of lungs, and one brother had been operated upon in this hospital for *genu varum*. About fifteen months ago this patient complained of pain in the left hip. The pain was intermittent, but had not prevented him from going to school or playing about; now and then he would limp; for different periods he would be free from pain and limping; no history of trauma. About six weeks ago, after a well interval, he complained of sudden pain in the left hip and began to limp. The pain in a day increased so rapidly that he went to bed, being unable to walk, and that night, for the first time, cried out from pain. Being more comfortable the next day he was taken to a hospital where he remained a few days, and left with a brace. Yesterday, twenty-four hours before admission, he fell on the brace and had passed a very uncomfortable night.

*Examination.*—The left hip was so tender that any attempt at motion produced much pain, and an examination was made with difficulty. There was flexion ( $40^\circ$ ), abduction ( $45^\circ$ ), but no eversion. From April 20th to May 12th (22 days) the patient was placed in extension, and was more comfortable. Measurements made on the last day showed apparent shortening of .5 cm., due to slight adduction, but no real shortening. The hip was still very tender and fixed. April 29, reaction to tuberculin. From May 28th to July 2nd, although the patient was in extension, night cries increased and he was uncomfortable. From July 2nd it was noticed that there was a fullness in Scarpa's triangle. The hip was still very painful and fixed in a position of flexion and adduction. For this reason an operation was decided upon.

July 3, 1899. Operation (Dr. Cushing): Ether; anterior incision. The joint capsule was distended and thickened; no evidence of rupture. On incising the capsule, about an ounce of seropurulent fluid escaped. A part of the cartilage over the head was roughened and slightly elevated from the bone. The joint cavity was full of tubercular granulation tissue. In places one could see that the cartilage of the acetabulum was eroded and lifted from its base. A portion of the anterior surface of the head and neck was chiseled away, showing the epiphysal line. No focus of disease in the bone was found. The area of most marked erosion of the cartilage, and the erosion of the bone at the edge of the epiphysis, as shown in (Fig. 6, *a. a. a.*) were chiseled away. After disinfection



CASE III. FIG. 6.—*a. a. a.* Areas of superficial erosion. *b. b.* Areas removed.

of the joint and bone cavity, dry iodoform was dusted in the wound, which was closed without drainage. The operation lasted one hour and five minutes.

For a few days previous to operation the pulse ranged between 90 and 100, and for three days after operation it ranged between 120 and 150; the temperature rose to  $102^\circ$ . By the seventh day pulse and temperature had reached normal. The patient was comfortable.

On August 2nd (thirty days after), a small sinus opened in the wound, discharging a clear, serous fluid, which completely healed on August 29th. Measurements made on August 30th showed a lengthening of 1 cm. and no real shortening. The flexion had disappeared, and there was a slight tendency to outward rotation. Motion in the joint was much less restricted. On August 31st, two months after the operation, the patient was fitted with a brace. On September 6th he left the hospital wearing a brace.

In this case the usual orthopedic treatment of extension and rest in bed had been given a fair trial, but did not relieve the symptoms. At the operation, tension was relieved by incision and drainage of the distended capsule, after which the patient was much more comfortable. The incision of the capsule also allowed

correction of the flexion, and a short time after the operation all movements of the hip joint were freer and without pain.

**CASE IV.**—*Tuberculosis of left hip, of one year's duration. Operation: Distended capsule, with purulent material; synovial membrane converted into granulation tissue; slight erosion of head and neck and acetabulum; wound closed; healing per primam. Result, January, 1899, six months, excellent.*

Surgical No. 9234. W. C., colored boy, *æt.* 2 years. Admitted July 26, 1899. One year ago the child complained of pain and tenderness in the left hip, and in a few days began to limp. The parents noticed that the leg became shorter; the pain was worse at night, and there were night cries. The child continued to walk a little.

**Examination.**—The general condition was good; no evidence of rickets. The left leg was flexed to 70 degrees at the hip and 45 degrees at the knee, and adducted. Motions at the hip are restricted in all directions, but not at the knee. It was difficult to make accurate measurements, but there appeared to be no real shortening.

August 2nd (six days after admission). Operation (Dr. Mitchell): Ether; anterior incision. The capsule of the joint was thickened and oedematous. On incising the capsule, an ounce of thin, brownish, purulent and necrotic material escaped. The synovial tissue seemed to be converted into granulation tissue. There was noticed a slight erosion on the anterior and superior surfaces of the neck at its junction with the head; round ligaments, intact; the rim of the acetabular cavity was covered with grayish granulation tissue; both of these areas, as well as the capsule of the joint, were curetted. The wound was irrigated with salt solution, dusted with dry iodoform powder, and closed without drainage. The full time of the operation was fifty-five minutes.

Pulse previous to the operation was 120; during the operation, 140. The chart registers an average pulse of 120 previous to operation and one rise of temperature to 103°, which, however, followed tuberculin given on the 27th of July. Following the operation the highest temperature was 101.5°, the evening of the first day, and the pulse rose to 180, but fell that evening to 130; up to November 27th, when patient was discharged, the average pulse was from 110 to 120. With the exception of a slight rise of temperature to 103° on October 2nd, there was no fever after August 4th, 48 hours after operation. The patient left the hospital on November 27th in plaster. The wound healed per primam.

**CASE V.**—*Tuberculosis of left hip. Subgluteal extra-articular abscess. Operation: Incision of abscess and arthrotomy; tubercular synovitis; erosion of head and neck; posterior perforation of capsule. Result, January 1, 1899, two months, improved.*

J. W. G., colored boy, *æt.* 2 years. Admitted November 9, 1899. The parents not being with the child it was impossible to get a history.

**Examination.**—The child is placed flat on his back. The left anterior iliac spine (the affected side) is a little lower than the right. There is a marked lumbar lordosis unless the left hip is flexed to a position of 90 degrees; motion at the hip joint in this position is possible in all directions, but only to a few degrees. The knee is flexed to an angle of 90 degrees. Extension is only possible to a few degrees; no rotation of thigh. If the right leg is placed in a similar flexed position at the knee and hip, there is an apparent shortening of about 1 cm., but no real shortening of the left leg. Between the anterior iliac spine and trochanter on the outer surface of the left thigh and beneath the gluteal muscles there is a fluctuating swelling.

**Operation.**—November 11, 1899. Ether. Under complete narcosis the leg can be very slightly flexed and extended. This restriction almost completely disappeared after the abscess was incised. The abscess was situated beneath the gluteal muscles and fascia

lata and contained thick, gelatinous, purulent material, with shreds of necrotic tissue, and was found to communicate with the hip joint through a small opening in the posterior wall of the capsule. The joint capsule, which was not distended, was opened through the usual anterior incision. The synovial membrane was covered with tubercular granulation tissue. On account of the youth of the child, a large incision was not made, so that the head, neck and acetabular cavity were not seen, but with the index finger erosions were felt on the anterior surface of the head and neck, which were curetted. The abscess and the capsule of the joint were also curetted, swabbed with pure carbolic, irrigated with salt solution and filled with emulsion of iodoform and oil. The operation took fifty-five minutes. Very little ether was given. The condition of the patient at the end of operation was excellent.

January 15, 1900. The child is still in extension, which has reduced the flexion of both knee and hip from 90 to 35 degrees. There are no night cries. The patient appears to be perfectly comfortable. The wound is now a superficial granulating area.

**CASE VI.** *Tuberculosis of left hip, of seven months' duration. No relief of symptoms after one month's treatment with extension. Operation: Tense distended capsule; no bone focus of disease; slight erosion of the head, with loosening of articular cartilage; round ligaments separated; wound closed; healing per primam. In six weeks the wound reopened. Second operation. Result, January, 1899, after two months, excellent. Wound closed.*

Surgical No. 9117. G. B., *æt.* 4½ years; admitted June 26, 1899. One and one-half years ago the boy fell on the ice and bruised his left hip. An area of ecchymosis over the hip remained some days. Following the injury, however, there was no special pain complained of and no limp. Eleven months later (that is, 7 months ago), the parents noticed that the child began to limp, and complain of pain, first in the calf of the leg, later in the ankle, then in the knee. About two months later the parents noticed that the affected leg was shorter and the boy walked on his toes. In about a month he began to have night cries. For the past two weeks the boy has been unable to walk on account of pain.

**Examination.**—The left leg is flexed at the knee and thigh, with marked adduction; no rotation; very little motion at the hip joint. The patient was placed in extension from June 26th to July 24th. He cried a good deal at night, when asleep or awake. All attempts to overcome the flexion by extension were unsuccessful. Manipulation of the hip joint continued to be painful; for this reason operation was decided upon.

**Operation.**—July 24, 1899 (Dr. Cushing): Ether; anterior incision. After separating the muscles a very tense distended capsule was exposed; it was incised, and about an ounce of flocculent, yellow, serous fluid was evacuated. The joint, head and neck of the bone were thoroughly exposed. The round ligament seemed to be destroyed. When the thigh was flexed, one got a good view of the acetabular cavity. The lining cartilage seemed smooth. The cartilage over the head of the bone appeared to be loose. The head epiphysal line was exposed by chiseling. No focus of disease was seen. The wound was irrigated with salt solution, dusted with dry iodoform powder, and closed without drainage.

Dr. Cushing noticed that under an anæsthetic the leg could not be fully extended. As soon as the capsule was incised and the tension was relieved, full extension was possible. Time of operation about fifty-five minutes; pulse before operation, 120; during operation about 140. As in the previous cases in children there was a slight tachycardia after the operation for five days, and some fever for three days. The wound healed per primam.

It was noticed on August 5th, 11 days after operation, that the leg was but slightly flexed, very little adducted, but there was slight outward rotation. On the 14th of August there was no flexion. At this time he was sent into the country in a brace.

On September 6, 1899, about a month later, he was readmitted



to the hospital, not in as good condition as when he left. He had night cries and some pain. Twenty days after admission a sinus formed in the wound which discharged tubercular pus.

From September 28th to November 4th he was placed in extension. November 3d, measurements: Apparent shortening of 1 cm., and real shortening from trochanter to anterior iliac spine of about 1 cm. No abduction or adduction or flexion, but marked outward rotation. The hip is pretty firmly fixed in this position except that it can be slightly rotated in.

*Operation*, November 4, 1899 (Bloodgood): Ether. It was found that the sinus of the previous operation passed through the rectus muscle into the joint. At this second operation the joint was exposed by an incision which separated the tensor vaginæ femoris and gluteus medius on the outer side and the sartorius and rectus on the medial side. The sinus and cavity corresponding to the capsule of the joint were lined with tubercular granulation tissue. It was found that the head and neck of the bone were intact. A few pieces of partly separated cartilage were removed from the head of the femur. The outer surface of the neck was rough, soft and hemorrhagic. On extending the femur and pushing it upwards, the head of the bone moved a little in each direction. Under ether there was very little restriction of motion at the hip joint. The soft parts and bone surface were curetted, the exposed surfaces were swabbed with pure carbolic, the wound irrigated with salt solution, dusted with dry iodoform powder, and closed with a piece of protective drain into the joint cavity. No loss of blood; no shock. Time of operation was about sixty minutes. Average pulse about 140.

Following the operation there was a slight tachycardia for a few days, but no rise of temperature. The operation in this case was a secondary one and of less extent than others. The patient was put up in plaster and later in extension, and was much more comfortable than previous to operation. The wound was irrigated, and at frequent intervals swabbed with pure carbolic and filled with emulsion of oil.

*Note*.—December 9, 1899, 35 days after operation. Measurements between iliac spine and trochanter and iliac spine and malleoli are about equal. Position of leg after removal of extension is as follows: The left (affected) anterior iliac spine is elevated 1 cm., the left leg is rotated out perhaps a little more than the right (this outward rotation is much less than previous to operation). The apparent shortening (1 cm.) corresponds to the elevation of the iliac spine. There is no flexion. The motions of the hip joint are about 10 degrees in flexion and extension; adduction to a few degrees; no restriction of outward rotation; a marked restriction of inward rotation and abduction. Although the hip is pretty well fixed, the position could not be a better one. Attempts at motion are not painful. The wound has healed.

December 15, 1899. The patient is in the hospital, and is walking about on crutches, in a brace.

*CASE VII. Tuberculosis of left hip, of one year's duration. Subgluteal, extra-articular abscess and abscess beneath the adductor muscles. These abscesses developed during orthopedic treatment. Operation: Incision of subgluteal abscess; anterior arthrotomy of joint; anterior and posterior perforation of joint; abscess beneath adductors drained through joint; tubercular focus in neck. Result, January, 1899, two months, improved.*

Surgical No. 8201. Boy, æt. 8 years. Admitted October 6, 1898, one year ago. The arthritis of the left hip had been present one year, following traumatism. The limb was in a position of flexion (28 degrees) and adduction (21 degrees), with slight internal rotation. Apparent shortening, 4 cm.; real shortening (anterior iliac spine to trochanter), 1 cm. Muscle spasm was marked. There was no evidence of abscess. The patient was placed in bed in an extension apparatus, which at once relieved the pain. He was discharged February 28, 1899 (five months), wearing a splint, and

appeared to be in excellent health. This patient was readmitted October 1, 1899, not because he was suffering any pain or discomfort, but in answer to a letter inquiring as to his present condition. He was still wearing the splint and walking with crutches. When the splint was removed and the patient placed in bed, and the anterior iliac spines fixed to the same horizontal plane, the left affected leg was so adducted that it crossed its fellow on a level with the patella. There was a large abscess behind the great trochanter in the gluteal region, and a slight fullness beneath the adductor muscles. The patient was observed in the hospital from October 1st to October 28th. There was no fever. He suffered no pain except when the apparatus was removed or when forced motions were attempted at the hip.

*Operation*.—October 29, 1899. Ether. The gluteal abscess was incised. It was situated between the gluteus minimus and medius and extended down to the middle third of the leg beneath the fascia lata. Passing the index finger, one could feel the capsule of the joint on its posterior surface. In this position a probe found communication with the joint cavity.

The usual exploratory incision on the anterior surface of the thigh was then made. The capsule of the joint when exposed was slightly distended, but on its outer surface there was no exudate and no adhesions. When incised, it was slightly thickened, and the joint cavity contained a moderate amount of seropurulent material filled with cheesy necrotic masses. The head and neck of the bone were easily felt and seen, and on the anterior and slightly inferior surface of the neck, near its junction with the head, a small tubercular bone focus was found. (Similar to Case I, Fig. 1.) This was removed with a chisel. The head of the bone seemed firmly in place in the joint cavity, and there was very little restriction of motion. The rim of cartilage which could be seen was not eroded. By pressure over the thigh in the adductor region, a great amount of tubercular pus was expressed into the joint cavity, and the finger and probe demonstrated a second opening in the capsule of the joint leading to a large abscess cavity on the lateral surface of the thigh, beneath the adductor muscles. This opening was enlarged and the cavity curetted out. The patient had a comfortable convalescence. January, 1900. Extension has corrected to some extent the adduction and flexion. The patient walks well in his brace. The wounds are almost healed. The marked adduction will need further operative treatment.

*CASE VIII.—Tuberculosis of right hip; orthopedic treatment for 12 months, during which time an iliac abscess, from perforation of the acetabulum, developed. Operation: Incision of abscess and arthrotomy of joint; tubercular synovitis; slight erosions of head and neck, with partial separation of the articular cartilage of head and acetabulum. Result, January 1899, two months, excellent.*

Surgical No. 8086. R. H., æt. 4. First admitted September 7th, 1898, with the following history: About five months ago it was noticed that the child limped; at the same time the parents noticed that the right ankle was swollen. Six weeks later the child awakened at night, crying from pain in the hip; next day was unable to walk; this pain and inability to walk disappeared in a few days, the night cries and pain at night continuing. About eight weeks ago a slight trauma was received by the right knee; The knee became swollen and was put up in plaster by a physician. Night cries continued. The hip became more stiff.

*Examination.* The child walked into the hospital. The limb is flexed; slightly adducted; no rotation of foot; apparent shortening of about 1 cm; no real shortening between anterior iliac spine and trochanter; no fullness in Scarpa's triangle; adduction is impossible, and there is about 10 degrees of abduction. Patient was placed in extension September 25th. 18 days later, he was discharged from the hospital, wearing a brace and using crutches, with a high shoe on the left foot. March 29, 1899, 7½ months, patient was readmitted.



**Examination.** Perfectly comfortable. Night cries have ceased. Examination reveals no muscle spasm. There is no flexion, abduction or adduction. Apparent shortening is  $\frac{1}{4}$  cm. There is very little motion at the hip. No real shortening between trochanter and anterior iliac spine. May 6th, 37 days, discharged, wearing a splint and using high crutches and high shoe. On October 27, 1899, five months latter, he was readmitted, not because of any pain or discomfort, but on account of swelling which had been noted for two weeks over the outer third of Poupart's ligament. **Measurements:** No apparent shortening; no real shortening. Leg is in a straight position, slightly rotated out. Flexion is possible to 30 degrees; abduction to 10 degrees, but adduction is impossible. There is only slight muscle spasm, associated with attempts at motion. On account of the abscess an operation was decided upon.

**Operation.**—November 4, 1899. Ether. Usual anterior incision, which also opened into the abscess. The abscess cavity was between the skin and fascia of the muscle. From it a sinus led below Poupart's ligament, passing between the sartorius and tensor vaginæ femoris, then into the iliac fossa, anterior to the sheath of the iliac muscle. After curetting this abscess cavity the joint capsule was exposed by separating the rectus from the tensor vaginæ femoris. No infiltration of the tissues outside the capsule. By pressure over the capsule a purulent material was expressed from the sinus, but on opening the capsule of the joint a direct communication could not be found. The cartilage of the head of the femur was soft and separated easily; it was removed by catching it with a clamp. The base consisted of soft hemorrhagic bone, the gross picture of tuberculosis. The anterior surface of the head and neck was chiseled. There was no evidence of disease in the neck, which seemed to be confined to the head of the bone, especially beneath the cartilage. The round ligaments had been torn and that portion of the acetabular cavity which was exposed showed evidence of disease. The cartilage was soft, and some could be pulled away, leaving a base of soft hemorrhagic bone. No attempt was made to find out the direct communication between the joint and the iliac abscess, as it would have required too much destruction of bone. The abscess cavity was traced into the pelvis between the iliac and the psoas muscle. The wounds were swabbed out with pure carbolic, irrigated with salt solution and dusted with dry iodoform. A protective drain was left into the abscess cavity and into the joint. Time of operation was about one hour and thirty-five minutes. Patient was in excellent condition.

Following the operation there was the usual tachycardia pulse of 130 to 160 for about ten hours; no rise in temperature; no pain or discomfort.

**Examination.**—December 1, 1899, twenty-seven days since operation. There is no apparent shortening. The anterior iliac spines are about even. Both legs are straight; no outward rotation; no real shortening; position of the leg is perfect. Flexion, extension, abduction and adduction and outward rotation are possible only to a few degrees. Inward rotation from a position of outward rotation is possible to a greater extent than outward rotation. Attempts at motion give no pain.

Wound healed except a small granulating area and a sinus communicating with the abscess cavity. Patient is ordered brace, high shoe and crutches.

January, 1900. No change.

**CASE IX. Tuberculosis of right hip. Slight symptoms four months; very acute symptoms three days. Operation at once. Capsule distended, very tense; synovial membrane hyperemic; on chiseling outer table of neck, a definite bone focus found in the neck near epiphysal line. January 1, 1900, six weeks, excellent result.**

Surgical No. 9699. N. K., æt. 40. Admitted November 22, 1899. In July (four months ago) patient began to have pain in the right hip, and he stopped work and rested for about two weeks. Was comfortable when he kept quiet. Returning to work, he was free

from pain for a couple of weeks, but since that time he has found that he has to rest quite frequently during the day when these attacks of pain come on. He is a butcher by trade and has to stand a good deal. Three days before admission, while at work, he was seized suddenly with severe pain, so intense that he went home to bed, and sent for a physician who gave him morphia, but this did not relieve the pain. He was brought to the hospital on a stretcher in the ambulance.

The right leg was fixed in a position of flexion of about 45 degrees. Any attempt at motion was intensely painful. Extension was at once applied in this flexed position, which in a few hours relieved the patient of the pain. Next morning he was more comfortable. On examination there was a distinct fullness in Scarpa's triangle. The history and the present condition were similar to the attack in the left hip joint (Case I). There is no apparent or real shortening. The result in the left hip is a perfect one. The patient was in extension with complete relief of symptoms from November 22nd to November 27th, but any attempt at motion gave him pain. Chart records a temperature between 99° and 101°; pulse of 70 to 80.



CASE IX. FIG. 7.—a. Tubercular osteomyelitic focus. b. Area of outer table chiseled to expose and remove a and b. c. Area of softened cancellous bone.

**Operation.**—November 27, 1899. Cocaine and chloroform. The usual anterior incision was made without difficulty under cocaine, but it was found that the retraction of the muscles necessary to expose the hip joint was so painful that chloroform was given. As soon as the patient was under the anæsthetic it was still found that complete extension was impossible. The capsule of the joint was distended. On incision a fluid spurted out, demonstrating the great tension. It was a seropurulent fluid filled with coagulated lymph. On examining the capsule carefully, it was found that the synovial membrane was intensely injected and hyperemic. There was no evidence of granulation tissue. The head of the bone was easily seen in the acetabular cavity, and the cartilage, both on the head and acetabular rim, seemed normal and was not sepa-

rated. No disease could be seen at the head or neck or trochanter of the femur. The bone of the anterior surface of the neck, between head and trochanter, was chiseled (Fig. 7b), and in the epiphysal line, between the head and neck, on the anterior and inferior surface, a small focus (about 5 mm. in diameter) of definitely tuberculous bone was found (Fig. 7a). Surrounding this and extending into the head and neck, the bone was soft and hemorrhagic (Fig. 7c.) The tuberculous area and this softer cancellous bone were removed with the curette. The appearance of the bone lining the cavity was normal except perhaps slightly hemorrhagic but firm. The bone cavity and joint capsule were swabbed out with pure carbolic, irrigated with salt solution, and the bone cavity allowed to fill with blood mixed with iodoform. The wound was closed with a small drain extending into the capsule but not into the bone cavity. Operation required two hours and ten minutes. There was no shock, and the condition of the patient at the end of the operation was excellent.

*Examination.*—December 16, 1899. Wound is healed with the exception of a small sinus which was filled with iodoform and organized blood clot. Patient has had absolutely no discomfort since operation, and for about seven days has moved his right hip in every direction, and we find on examination to-day that one is able to flex, abduct and adduct, rotate in and rotate the hip outwards to quite a marked degree, but not completely. These motions are without pain. January 12, 1900. The patient is up on crutches; the wound is healed except a small superficial area. Passive and active motions with hip are but slightly restricted and give no pain.

For some years before this report, which I made to the Society in May, 1899, I had given a good deal of consideration to the subject of tuberculosis of the joints, and especially of the hip, and had been forced to the conclusion that there was much room for improvement upon the usual orthopedic treatment. I had in mind early exploratory operations in which the surgeon might be fortunate to find the focus of the disease in the bone at a period when its complete excision; or, if the tubercular osteomyelitis were more extensive, a partial excision might be done without interfering with the continuity of the bone or function of the joint. From early experiences, especially in the knee, arthrotomy with irrigations with antiseptics and injections of large quantities of iodoform seems to have been the best procedure for treatment of the tuberculosis of the synovial membrane.

The majority of surgeons now follow the more conservative and orthopedic treatment. In the past many, and at present, without doubt, some, surgeons resort to operation, even early in the disease, but as a rule such operations have been accompanied with excision of at least the head of the femur and frequently more, of the neck and trochanter.

My first object in the early operation for tuberculosis of the hip was to avoid a complete removal of the head or of an amount of bone sufficient to interfere with the continuity of the upper end of the femur, or function of the joint, to excise the diseased bone only in small areas by a gouge and curette, trusting to antiseptic irrigation, and especially to the healing process, to check the further extension of the tubercular processes, and to encourage healing of the tissues already diseased, both of bone and soft parts. Every surgeon must have observed, especially in excisions of the knee, that tuberculous bone has frequently been left behind, but that the disease has been cured. Change of circulation, due to the operative interference, and the scar tissue of the healing process, both seem to exert a curative influence on the tubercular tissues.

The more frequently one operates, and the earlier in the disease, the more frequently he may be fortunate in finding single focus, of tubercular osteomyelitis which can be completely excised without injury to the continuity of the bone or function of the joint as in Cases I and IX. As our experience grows, I trust we will find that early operations check the disease with more certainty and in a greater number of cases than the usual orthopedic treatment. I trust also we will find that it shortens the period of treatment.

In five of these cases the joint capsule was greatly distended. It would seem beyond question that arthrotomy and irrigation in such cases are the only reasonable treatment. The symptoms due to tension are relieved, and both the infiltrated and uninfiltrated tissues, relieved of this pressure, are better able to take care of the tubercular process. In addition, the arthrotomy allows a thorough local disinfection of the surfaces of the capsule and bone, and with the aid of a small gouge one is able to explore the trochanter and neck and head of the femur without endangering the continuity of the bone. In this early exploration, any focus of bone can be completely or partly excised according to its extent. Loose articular cartilage, both on the head of the femur and on the acetabulum, can be removed and the diseased bone beneath subjected to local disinfection.

From these observations it would seem that in many cases of tuberculosis of the hip, synovitis with effusion is present early in the disease; in a number of cases the capsule ruptures and extra-articular abscesses form. An anterior arthrotomy, if performed before rupture takes place, would effectually prevent this complication.

In three of our Cases, Nos. V, VII and VIII, extra-articular abscesses were present at the operation. The joint capsule in these three cases was not distended but perforation and communication with the abscess cavity were found in each case. In addition to the incision of the abscess, the joint was opened by the usual anterior incision and drained. In Case VII there were two abscesses; the one beneath the adductor muscles, on the inner lateral surface of the thigh was drained through the joint capsule. Microscopic examination of the wall of abscesses from tuberculous bone, demonstrates, especially early in the disease, that the wall of such "cold" abscesses is composed of ordinary granulation tissue. We seldom find evidence of tuberculosis. Clinical observations demonstrate that extensive excisions of the abscess wall are not necessary. The most important point in the treatment is the removal of the source of infection in the bone. For this reason in operations for tuberculosis of the hip in which extra-articular abscesses are present, I believe it is better in every case to simply incise the abscess, curetting and thoroughly disinfecting in addition, if you wish, but most important of all in every case to explore the joint and search for the focus of tubercular osteomyelitis. We however, will have to wait before forming definite conclusions, and compare the immediate and ultimate results in these cases with those in which the extra-articular abscesses have simply been incised. Recent observations, however, have impressed me with the value of early exploratory arthrotomies in tuberculosis of the hip, not only for a confirmation of the diagnosis early in the disease, but for treatment.



In all the joints, especially the hip and knee, the synovial sac can be thoroughly disinfected and filled with iodoform, and with a small chisel the more common positions for the tubercular focus can be explored. To open and irrigate a normal joint, even with 1:1000 bichloride of mercury solution, is not followed by any restriction of motion, and Case I demonstrates that the hip joint can be drained for six weeks and yet almost complete restoration of the function result. Anterior arthrotomy of the hip is a simple operation and its dangers should be confined almost entirely to the danger of the anæsthetic. However, it must always be borne in mind that a virulent pyogenic infection of the wound at the operation or later would be a serious complication, and if we found that this occurred with any degree of frequency, it would most certainly detract from the results, even in comparison with the orthopedic treatment. More extended experience will be necessary before we can judge of the risk of infection. (There has been no infection in our series of 12 cases.)

The anterior incision in cases of tuberculosis of the hip is not a new procedure. Mr. Barker (*Manual of Surgical Operations*, 1887) describes it as R. W. Parker's operation. More recently, in Treves' *System of Surgery*, Mr. Barker again gives this incision first place, and in addition states that Professor Hueter, of Greifswald, described a similar method independently but at about the same date of Mr. Parker's. (*Transactions of Clinical Society of London*, 1880, page 105.) Bradford and Lovett (*Orthopedic Surgery*, second edition, 1899) describe the anterior incision for the excision of the joint, but prefer the posterior incision. As far as I am able to find in the more recent authorities, the suggestions made and the methods followed in these cases are sufficiently original to justify their publication.

To repeat, the chief object in the early operation for tuberculosis of the hip is to take the disease in its early stage, to relieve the tension of the distended capsule, to check and cure the tubercular synovitis by disinfection and drainage, to explore the bone with the hope of finding the tubercular osteomyelitis, in which case it can be partially or completely excised; trusting also to disinfection, drainage and the healing process to check and later cure the disease of the bone without injury to its continuity. The acetabular cavity can be explored, as shown in (Fig. 5*b*) by chiseling through the head; more extensive operations on the acetabulum, however, could not be performed without removal or temporary dislocation of the head. It is too early to judge of the results, except in Case I, in which the patient has now a perfectly functional joint one year after operation.

In operations for tuberculosis of the joints, one must always bear in mind the possibility of disseminating the tubercle bacilli. In operations on joints where the Esmarch can be used, this danger may not be as great as in operations on the hip and shoulder. It will require, however, a number of years and careful observation to get at data for this study. The method of operation is clearly described in the details of the history of the nine cases reported. The most important anatomical point is to bear in mind the deep external circumflex vessels. Sometimes it is not necessary to divide these, but if it is found that more room is required, these vessels should

be carefully ligated. The joint can be exposed easily without dividing the muscle by separating the tensor vaginae femoris and the glutei muscles on the outer side and the sartorius and rectus to the inner (medial) side. I believe it is a better plan to lengthen the incision rather than to make a cross cut of the muscles. The separation of the muscle leaves a cleaner and a less ragged wound, and perhaps detracts much from the danger, not only of pyogenic infection but of tubercular dissemination. Through this wound, by separating the muscles, one can clearly see the capsule of the joint and the trochanter and upper portion of the shaft of the femur. On dividing the capsule, one can explore with great ease the neck and head of the femur. In these operations the head has not been dislocated from the acetabular cavity, but if one found the round ligaments destroyed, with extensive disease of the head and acetabular cavity, the head of the bone could easily be temporarily displaced to allow a better treatment of the head itself and the acetabular cavity, after which it could be replaced. This course was followed in a recent case by Professor Halsted.

#### DISCUSSION.

DR. HALSTED.—To indicate what we may hope for as a final result in certain cases of hip-joint disease, even when a considerable portion of the head of the femur has been removed, and in support of what Dr. Bloodgood has said, I will refer very briefly to a case which I intend very soon to report in full with other interesting hip-joint cases. The patient, a boy, thirteen years old on admission, had an acute osteomyelitis in 1895, at the age of eleven, which involved the entire diaphysis of the right femur. Eleven months he spent in bed, and for seven months could not lie on the affected side. After walking about with a cane and without much pain for more than a month he had to take to his bed again for about a week during a second acute attack of pain in the same bone. Two or three months later two abscesses appeared, one behind the knee and one internal to the trochanter. The boy was thenceforth for nearly a year quite comfortable and considered himself sufficiently well, until the 1st of November, 1897, when he was hit in the right groin by a wagon-pole. He suffered greatly from this blow, and the following morning could not flex his thigh. Two weeks later, November 19, 1897, he was brought to us by his physician, who stated that for several days he had been having very high fever with daily intermissions. The boy was emaciated; his expression anxious and indicative of suffering. He lay on his back; the right thigh was abducted, rotated outwards and slightly flexed; the groove in the right groin was obliterated and there was an appreciable fullness over the head and neck of the femur. Pressure over the joint and all attempts to move the head of the femur caused pain. About the level of the top of the trochanter of the right femur, but internal and anterior to it, was a sinus from which pus escaped. Behind the inner hamstring tendons was the orifice of a second sinus discharging more pus than the other. The femur was much enlarged, and the soft parts of the thigh were swollen. An involucrum had evidently replaced the entire diaphysis. A probe in the popliteal sinus touched rough bone. The measurements, which developed a fact or two of interest, I will give at another time.



*1st Operation. Nov. 24, 1897.*—EXCISION OF ONE-HALF (ANTERIOR) OF THE HEAD, NECK AND UPPER PORTION OF TROCHANTER OF THE RIGHT FEMUR BY FRONTAL SECTION. There was a small abscess containing only a few drachms of pus just below and in front of the capsule of the hip joint, which communicated with this joint. The wall of the abscess was carefully excised. Having made the frontal section of the trochanter, neck and head of femur, the extent of the disease in these parts could be accurately determined. The upper end of the soft sequestrum was cut off. The disease had involved the neck and head and had finally, perhaps just after the blow from the pole, infected the hip joint. By some oversight no drawing was made of the lesions in the head, neck and trochanter. Nowhere were there signs of active bone disease; there was a little sequestrum near the top of the trochanter, and a little, very slender bit of sequestered bone in the neck; the shape of the head and of the neck was not altered by the disease; the head of the bone had lost some of its cartilage, and granulations were growing from the denuded parts. The infection of the joint was probably recent, and it could be demonstrated how this might have taken place. It was not contemplated at the outset to do more at the first operation than to relieve the trouble about the hip joint, for the patient's condition contraindicated an extensive operation. The patient recovered promptly from this and from two subsequent operations upon the middle and lower thigh. As you may see in the photographs, the boy can extend his thigh perfectly, and can flex it to nearly a right angle. He walks without a cane and says that he finds the right thigh as useful as the left. The operated thigh is from 1 to 1.5 cm. longer than the other; and there are 2 cm. of apparent

lengthening on the right or operated side. This apparent lengthening is due in part to abduction and will undoubtedly disappear.

This case sheds a new light upon the surgery of the hip-joint, proving as it does that not only a useful but functionally an almost perfect joint may be obtained even when one-half of the head and neck of the femur have been removed by, approximately, a frontal section. We may, therefore, attack tuberculous cases in the early stages in some such conservative way, taking a fine and very thin slice from the anterior surface of the neck or head, or trochanter, or from all, and having located the disease, excise only as much as may be necessary. The acetabulum can be explored in a similar manner. If the disease is operated upon early it would probably rarely if ever be necessary to remove the whole head of the femur; and we may find that having removed a part of the disease the remainder, as in tuberculous peritonitis, may take care of itself the better for having been interfered with and assisted.

The hip joint, a simple ball and socket joint, promises more for these conservative operations than any other joint; large surfaces covered with cartilage do not lend themselves so readily to the formation of strong adhesions and ankylosis as the less simple joints; of all the joints the knee is perhaps the least suitable for conservative surgery. With its ligaments and reduplication of synovial membrane, with its fibro-cartilages and numerous recesses and pockets it furnishes conditions well suited to the propagation of the tubercle bacillus; and when the crucial and lateral ligaments have been much weakened by the disease, an ankylosed joint is usually more serviceable and more comfortable than one in which motion has been secured.

## GUNSHOT INJURIES BY THE WEAPONS OF REDUCED CALIBRE.\*

BY L. A. LAGARDE, *Surgeon, U. S. A.*

My first acquaintance with the military weapons of reduced calibre dates from a time when I was pursuing studies with firearms in this institution. I am, therefore, very happy to return here to-night to talk of guns and missiles with you.

In considering the effects of the modern arm, experimenters have generally studied it by comparison with the older weapon. I hold in my hand the Springfield rifle, calibre 45, which was used by our foot troops from 1874 to 1892. It is a single loader and in expert hands it is capable of delivering 20 shots per minute.

Its projectile has a velocity of translation of 1301 f. s., a velocity of rotation on its long axis of 800 turns per second, and a maximum effective range of almost 2000 yards. It is made of lead hardened with antimony, cylindro-conoidal in shape, weighing 500 grains, and is propelled by 70 grains of black powder.

I will now exhibit our present service rifle—the Krag-Jorgensen—adopted in 1892 for use by the foot troops. It is

a typical example of the reduced-calibre weapons at present in use by all the powers. It is provided with a magazine which holds five cartridges. In expert hands it is capable of delivering as many as 40 shots per minute. Its projectile weighs 220 grains, 30 calibre, composed of a nucleus of lead, enclosed in a hard steel mantle. Its velocity of translation is 2000 f. s., the velocity of rotation 2400 turns per minute; whilst it possesses a maximum effective range of 4000 yards, propelled by 37 grains of smokeless powder.

In some experiments which I conducted in 1892 at Frankford Arsenal, under the orders of the Secretary of War, my efforts were especially directed to the difference in destructive effects between the missile of the 45-calibre weapon, and that of a missile so similar to the Krag-Jorgensen bullet, that for all practical purposes they may be regarded alike.

We fired the two bullets altogether one hundred and ten times, into ten cadavers. Our aim was to traverse similar parts of the body or parts offering about the same resistance, with first one and then the other bullet at all the ranges—from 100 to 2000 yards. The ranges were not actual; they were simulated by reducing the charge of powder so that the projectile was

\*Read before the Johns Hopkins Hospital Medical Society, Nov. 10, 1899.

given the remaining velocity which was common to it for any given range.

*Impact.*—The first thing to attract our attention at the outset of our experiment was the difference in the amount of shock imparted to a member when hit first with one and then with the other bullet. The shock was estimated by the oscillation of a limb when suspended. As might have been expected, the greater sectional area and greater weight, of the 45-calibre projectile, caused greater shock than that noted by the smaller and lighter bullet on impact with a resistant bone. Indeed, the difference was so marked that it often happened that the presence of a fracture from the latter was only noticeable upon close inspection, whereas it was invariably predicated by the motion imparted to the member when traversed by the larger bullet. The shock from either bullet as judged by the motion to the limb, was nil when soft parts alone were hit.

The minimum amount of shock from the smaller calibre bullet has been the cause of much concern among military men. The English in the Soudan, and in the Ashanti campaign were so doubtful of the efficacy of this small calibre missile to arrest the impetus of savage tribes that they resorted to the practice of making their missile explosive by filing the nose through the steel casing enough to expose the lead core. This is the famous Dum-Dum bullet which takes its name from the place of its manufacture in India. When the lead is exposed, as stated, the projectile disintegrates on impact with a resistant structure. The fragments of the steel mantle and lead core, acting as individual missiles add greatly to the destructive effects in the foyer of fracture.

*Explosive Effects.*—Our observations with the old and new rifles were next directed to explosive effects. We noticed these so-called explosive effects with the new weapon up to 350 yards, whilst they were seldom exhibited with the old arm beyond 200 yards. Explosive effects in gunshot wounds are peculiar to rifle projectiles impressed with high velocities. Within the zone of explosive effects they are common in the experience of the military surgeon, whereas they are seldom witnessed by the civil surgeon whose experience is almost entirely confined to wounds by pistols, whose projectiles are possessed of comparatively low velocities.

In speaking of explosive effects, one should not confound the term *explosive effects with explosive action*. The latter term should be restricted to those wounds caused by an explosive bullet—that is, a projectile that explodes on impact. Such a projectile is hollow, charged with explosive materials which ignite when the bullet strikes against a hard substance, like bone. The bullet is thus torn asunder, causing usually an extensive lacerated wound. On the other hand the projectiles possessed of superior velocities do not explode on impact. They are solid, and at most, seldom become altered in shape. Indeed, those of the small calibre, enclosed in a mantle of the hardest steel, do not even deform when they collide with the most resistant parts of the human body; and yet they are proverbial for their explosive effects in the proximal ranges.

Explosive effects are well exhibited by firing the projectile of the old and new arm into tin cans at close range. For the

purpose of comparison, if the experiment is done by firing into tins when empty, and into another set of tins of similar capacity filled with water, the empty cans will exhibit no alteration in shape. The orifice of entrance and exit of the bullet will correspond in size to the sectional area of the projectile; on the other hand the tins that were filled with water will show great alteration in shape. The sides of the vessels will exhibit a bulging as if some interior force had exerted an outward pressure in all directions. The orifice of entrance will usually correspond to the calibre of the projectile, whilst the orifice of exit will be marked by a large irregular opening with everted edges.

If the experiments are continued upon a cadaver at close range, impact with a resistant bone will present certain characteristic features: The wound of entrance in the skin will correspond in size to the diameter of the bullet; the wound of exit will be marked by a bursting forth of the skin. "The track leading to the bone is conical in shape, the base of the core corresponds to the wound of exit in the skin, and the apex of the core corresponds to the seat of fracture. The bone is finely comminuted. A close inspection shows that the bony particles have been driven into the tissues at right angles to the bullet track; it is not uncommon to find bony sand in the wound of entrance."

Five theories have been advanced to explain these explosive effects.

1. Hydraulic Pressure.
2. Compressed air, or the projectile air.
3. Rotation of the bullet.
4. Deformation of the bullet.
5. Heating of the bullet.

1. *Hydraulic Pressure.*—The term "hydraulic theory" has been employed by many writers to explain the highly destructive effects often found in gunshot wounds at the proximal ranges. It is based on the principle of Pascal. This principle is only applicable to a closed vessel filled with liquid. In accordance with this principle if a certain pressure is made upon a given area of the imprisoned liquid a similar pressure will be exerted within on like areas of the vessel walls.

The experiments of Coler, Stephenson and others have effectually disproved this so-called hydraulic theory. They have shown that the highly destructive effects noted by firing into sealed vessels filled with liquid were to be noted in the same way when the vessels were unsealed. Ordinary tin buckets filled with water whether the tops were in place or not sustained the same amount of destruction.

2. *Compressed air, or projectile air.*—This is called the projectile air of Melsens, because it is he who recently revived this theory of projectile air in explanation of the destruction in wounds that so often suggest explosive action. Boys has succeeded in making exact photographs of bullets in transit. He caused the bullet to cross an electric circuit. At the moment of contact with the circuit the bullet and the immediate vicinity of its trajectory are illumined by a spark which serves to throw the image upon a photographic plate. A study of the views thus obtained distinctly shows a pad of compressed air in front of the projectile. Melsens believed

that this cushion of air entered the tissues at the moment the skin was penetrated or before, and that the destruction of tissues was to be accounted for by the explosion which occurred when the compressed air again regained its normal volume. The tissues fail to show any evidence of air having been forced into them, such as one might infer from the presence of emphysema, and altogether it may be said that the theory of projectile air has but little to recommend it to consideration.

3. *Rotation of the bullet.*—The rotation of a rifle bullet is imparted to it by the twist in the barrel. The longer the bullet the sharper must the twist be. The old Springfield 45-calibre bullet, which was but two calibres in length, and which revolved 800 turns per minute at the muzzle described one complete turn in 22 inches, because the twist in the barrel corresponded to one complete turn in 22 inches. In the present rifle the twist is sharper, viz., 1 turn in about 10 inches, and the rate of revolution is estimated at 2400 turns per minute. It is generally admitted by ballisticians that the velocity of rotation is well maintained,—that it does not diminish with the velocity of translation. Taking for granted that the projectile makes a complete turn in ten inches, we must admit that the rotation of the bullet can have but a minimum amount of effect to display in traversing a thigh bone which may be but one inch in diameter, because in traversing it the ball is making only  $\frac{1}{10}$  of a turn.

4. *Deformation.*—The fact that the old leaden bullet became deformed when colliding with a resistant bone, especially at short range, added greatly to the amount of destructive effects. Deformation can find no plea as a cause of destructive effect in all cases since the steel-clad bullet that does not deform is proverbial for the creation of explosive effects.

5. *Heating.* Heating of the bullet by the act of ignition to explain explosive effects found adherents long ago, and it was not until recent years that this erroneous notion was set aside. It is not necessary to explain to an audience like this in the very institution where the significance of heat imparted to missiles was forever determined. We were able to show in 1892 that the heat on a bullet caused by the ignition of the powder is not sufficient to destroy the ordinary septic germs. The experiments were conducted with missiles from low-velocity rifles and the weapons of reduced calibre with the same result. To speak briefly we can truthfully say that the heat of a missile cuts no figure in gunshot wounds.\*

The true cause of explosive effects is the superior energy possessed by the bullet at the moment of impact. The bone, and even the soft parts, receive a large amount of this energy and move "outwards in lines radiating from the long axis of the bullet-track with such a degree of force that they act as secondary missiles on the neighboring tissues and cause still further smashing and pulping of the tissues. Even fluid particles participate in this secondary action but it is all the more marked when fragments of bone are driven apart in this manner." (Stephenson.)

*Soft Parts.*—Our next experiment at Frankford with the

small-diameter bullet demonstrated that the wound of entrance was usually round, the size corresponding to the diameter of the bullet; the edges of the wound were at times clear cut, but more often they were rolled in and often blackened like the wound of entrance of the old leaden bullets. This, as you know, once gave rise to the idea that the edges of the wound were discolored by burning; but thanks to the assistance of Professors Welch and Councilman, as already stated, this idea was refuted for all time in the laboratory of this institution.

The wound of exit of the small-calibre bullet was generally larger than the wound of entrance, and beyond the zone of explosive effects especially it was generally round, marked at times by a mere slit; again it was star-shaped, T-shaped, semicircular, &c.; the edges were generally turned out.

*Diaphyses of long bones.*—Our next observations at Frankford Arsenal referred to the effects of the small-calibre bullet upon the compact substance of long bones. Here I may state that the destructive effects of the old and new bullet up to 350 yards were alike, and severe. Beyond 350 yards the lesion in the bony tissue changed perceptibly with the smaller bullet, the comminution was less, the fissures were larger, and the spiculae of bone were not so often detached. The general tendency with the little bullet between 500 and 1500 yards was to inflict a wound approaching a perforation, although a clear-cut perforation in the diaphysis itself was seldom seen. At 2000 yards the small bullet showed a tendency to again shatter the bone.

*Effects upon the epiphyseal ends of long bones.*—Clear-cut perforations were generally observed when the small bullet traversed the spongy ends of bones. This was especially true after the zone of explosive effects and even within this zone—350 yards—complete perforations with little or no fissuring were often seen.

*Actual Conditions.*—Of the wounds noticed in Cuba during the Santiago campaign I may add that they partook the general characters of the wounds that I have described as experimental wounds. The wounds of the soft parts healed immediately, without an exception to my knowledge, under antiseptic dressings. The wounds of joints, including the knee, elbow, shoulder and hip were immobilized, dressed antiseptically, and they all did well. The wounds of the skull, including brain substance almost invariably suppurated, owing no doubt to the amount of dirt introduced from the scalp with the bullet.

*Wounds of the lungs.*—Those that survived 24 hours generally did well. In the majority of instances it was difficult to restrain the men after two or three days.

The wounds of the abdomen were generally fatal. Four or five men recovered with gunshot wounds that appeared outwardly to have perforated the intestines, but no actual proof of such perforation was obtainable. I was told that three laparotomies for gunshot injury of the abdomen were done at one of the field hospitals. The patients all died in a few hours after operation. For many reasons laparotomy for gunshot wound in the abdomen on the field was not considered safe or practicable. Upon the whole, the gunshot injuries by the Mauser, the reduced-calibre rifle of the Spaniards, were in keeping with those humane effects so confidently predicted by

\* Proceedings Pan American Congress for 1893, Vol. 1. N. Y., Med. Record, Vol. 47, No. 25.



experimenters generally. The wounds of soft parts healed without suppuration. The lesions of bone that formerly caused such a high mortality in the statistics of wars were most successfully treated by antiseptic dressings and the proper use of immobilizing materials. Comminution, and fissuring were noticed in the diaphyses. It was, however, seldom necessary to cut down for the purpose of removing spiculae of bone, as the displacement of fragments did not require this amount of interference. The clean-cut perforations of the epiphyses, without fracture, rendered joint injuries the most favorable of all bone lesions for rapid healing, with little or no loss of function. This was especially true of gunshots of the knee.

The difference between the gunshot wounds of civil and military hospitals will be more marked in the future. The civil surgeon will continue to treat pistol-shots in which the balls often lodge. Some lesions from this source often show complete separation of fragments, which necessitates cutting down. The joint lesions are often severe, necessitating the opening of the joint, under antiseptic precautions, turning out blood clots, removing fragments, etc. Such precautions are necessary to insure against sepsis. On the other hand, it may be said that the action of the steel-clad bullets from the present military weapons and the use of antiseptics have so modified the results in the gunshot wounds of warfare that the burden of the military surgeon and the sufferings of the patient, immediate and remote, will be very much lessened.

#### DISCUSSION.

EXHIBITION OF RADIOGRAPHS SHOWING RESULTS OF SMALL-CALIBRE INJURIES.—DR. W. C. BORDEN, U. S. A.—During the late war I was stationed at Key West with an X-ray machine, and from a study of the wounded soldiers I have arrived at some general conclusions relative to the effects of the small-calibre bullets on the human body, more particularly upon the bones. Dr. LaGarde has gone over the consideration of the theoretical effects of the bullets and these pictures will show the clinical effects as demonstrated by the Roentgen ray.

It seems to me that there are four main elements that influence the effect upon bone tissue—(1) the velocity of the bullet—(2) the part of the bone struck—(3) the angle of incidence and (4) the form of the bullet. Clinically, there is one thing above all others that affects the course of the case, and that is the presence or absence of sepsis in the wound.

When the bullet is traveling at extremely high velocity the explosive effects are produced whether the bullet strikes the bone, I mean now the shaft of the bone, at any angle or in any part. For instance, if it strikes the bone perpendicularly, it will produce a bad fracture, and it will do this equally if it merely grazes the bone. When the bullet strikes the bone laterally, merely grazing the periosteum at a high velocity, it produces a fracture that may be termed a fracture by contact. Here is an illustration (showing radiograph); the bullet passed across the front of the forearm, just grazing the radius, and yet, as you see, it shattered the bone completely; and here is an example showing a similar effect upon the hand at short

range. In this case the whole distal end of one of the metacarpal bones has been blown completely out, and yet the wound of exit was very little larger than the wound of entrance; the range was five hundred yards.

So much for the effect upon the human body when the velocity of the bullet is at its greatest. Now, the angle of incidence seems to me to have a marked influence. When the bullet strikes the bone in the median line with perpendicular impact, it shatters the bone as badly as if it were within the explosive range. Here is an illustration of a fractured thigh, in which the bullet went straight through, striking the femur with a median impact, and you see how badly the femur is shattered. In a little over a year after the injury I radiographed this same case; the wound had healed readily without any suppuration, and though there is a tremendous callous formed about the fracture, the position and function of the limb are almost perfect. Now as to tangential impact, when the bullet strikes the bone at an angle the fracture and fissuring are not so great, no matter what the range may be, provided it is outside the explosive zone. In this case (showing radiograph) the bullet struck the outer side of the radius, tore off a piece of bone and made a straight fracture.

Now as to the form of the bullet. Dr. LaGarde has spoken only of the bullet as it strikes after passing through the air; but in war it may ricochet, strike some object, become deformed and then strike the body. In these cases the effect of the bullet is decidedly different from that of the plain undeformed bullet. In this case (showing radiograph), for instance, the bullet struck some object before it hit the man, and the whole end of it became flattened so that it was practically like a Dum-Dum bullet. The velocity was low, for the bullet lodged in the tissues and yet because of its extreme deformity when it struck the bone it shattered it immensely. Here is an injury of the same class showing two bullets in the same limb. Both bullets were deformed and the shattering was very great. Here is a photograph of several Mauser bullets removed after X-ray examinations of the patient. All but one of them are deformed.

Here is a rather interesting radiograph showing the passing of a Mauser bullet through a phalanx. The bullet is so small and travels with such velocity that it may pass through a finger and not tear it off as would a larger bullet. Relative to this case I would say that gunshot injuries of the hand always cause some permanent loss of function. This is due to injury to the soft parts; and in regard to injury to the soft parts by the small-calibre bullet I would say that we have had a great many cases where, though the bones were markedly shattered, if the soft parts were not much torn there was not much loss of function; but if the soft parts were greatly disturbed, the resulting cicatrizing tissues caused considerable disturbance of function.

The injury produced by these bullets to the ends of long bones is quite different from that of the shafts. In the shaft the fissuring and comminution are always greater than in the extremities. Whatever the theory of explosive effect may be it is certainly true that the dense tissue of the shaft transmits the shock more than the softer tissues and causes greater solution of continuity.

Concerning the humane effect of these bullets I should say that where they do not kill outright they are certainly much more humane than the old bullets were. I saw some cases,—one I remember in particular—where the bullet passed through

the abdomen, directly through the liver, and yet the patient was up and ran away from the hospital eleven days after receiving the injury.

## A RECONSTRUCTION OF A GLOMERULUS OF THE HUMAN KIDNEY.

BY WILLIAM B. JOHNSTON.

(From the Anatomical Laboratory of the Johns Hopkins University, Baltimore.)

WITH SIX FIGURES.

Since the appearance of Carl Ludwig's article upon the Kidney in 1872,\* in which he devotes but a few words to the structure of the glomerulus, and in which are reproduced a few drawings of the glomeruli of mammalian kidneys, other investigators have been inclined to pass over this part of the vascular mechanism of the kidney, mentioning only its afferent and efferent vessels. The difficulty of seeing anything but the exterior of a glomerulus has, of course, always obscured its intimate structure. For these reasons it has appeared advisable to make a more careful study of the arrangement of the blood-vessels of the glomerulus by means of the method of reconstruction.

The requirements for such a reconstruction are a perfect set of serial sections through a well injected glomerulus, the sections being thin enough to pass at least twice through any of its vessels which may be struck parallel to the plane of cutting, as well as a conception of the outward form of the glomerulus previous to cutting.

Preliminary injections of the dog's kidney with a variety of substances brought out the advantages of a supersaturated aqueous solution of Berlin blue over other injection masses, and the advisability of selecting and cutting a single glomerulus. Adult human kidneys from the autopsy table were usually abnormal and always failed to be well injected. In order, therefore, to obtain a good injection of a normal glomerulus, the kidney of a child three months old, dead but a few hours, was injected in situ through the abdominal aorta until the Berlin blue appeared in the renal vein. The difficulty of obtaining a faultless series of very thin sections was greater than that of selecting and cutting out a well-injected glomerulus from clear bits of this kidney, though very many seemingly perfect glomeruli proved to be but partially injected. A chosen glomerulus from the child's kidney was imbedded in paraffin in the usual way and cut into serial sections  $3\ \mu$  thick. The 34 sections through this glomerulus were then stained in Upson's carmine and mounted in balsam. Drawings of each of these sections enlarged 1333 diameters, the greatest convenient enlargement, were made with a camera lucida (Figs. 4, 5, 6) and the corrected drawings transferred with carbon paper to wax plates 4 mm. thick, *i. e.* 1333 times as thick as the original sections.

Before beginning the reconstruction, that part of each plate representing the glomerulus proper was cut out, the line of incision following the outer borders of the external vessels, leaving Bowman's capsule in the outer shell. The remaining wax shells thus obtained were carefully piled in order, and a plaster-of-Paris cast made of the cavity. The solid cast roughly indicated the external form of the enlarged glomerulus. As a further guide to the reconstruction, the sections of the blood-vessels appearing in each plate were cut out with the exception of wax bridges connecting them. The internal relation of these sections in wax representing the blood-vessels was thus preserved, which aided materially in piling and blending the individual sections.

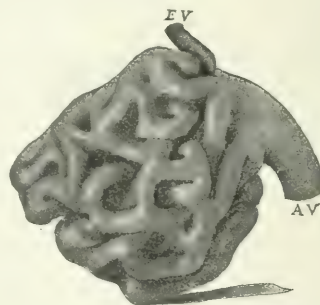


FIG. 1.—Wax model of the glomerulus, enlarged 444 diameters, seen in profile from the left side. A V afferent vessel; E V efferent vessel.

From the model thus made it appears that the afferent vessel of the glomerulus, after entering the capsule of Bowman, immediately divides into five diverging branches, which with their subdivisions and with the efferent vessel form an almost spherical tuft of blood-vessels. For the sake of description we may assume that the glomerulus is suspended from its afferent vessel. The efferent vessel originates, roughly speaking, from a loop of capillaries which projects in the equatorial plane from the side of the glomerulus opposite the afferent vessel, but to the right of the median line (Fig. 2 E. V.). From this point the course of the efferent vessel is upward, inward, and to the left, grooving the superior surface of the glomerulus and dividing it into two unequal parts. This vessel leaves the glomerulus a little superior and

\* Handbuch der Lehre von den Geweben des Menschen und der Thiere. S. Stricker, Vol. 1.

anterior to the point where the afferent vessel divides and in a direction opposite to that of the efferent vessel. (Fig. 1.)

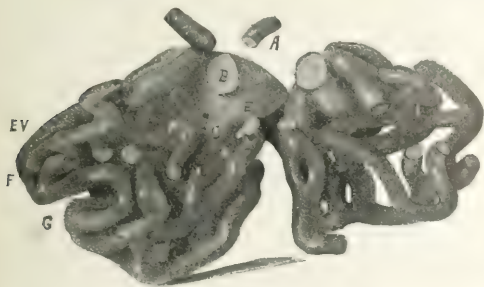


FIG. 2.—Wax model of the glomerulus, same enlargement and same view as in Fig. 1. The left lateral group of capillaries is separated from the median group and turned back, exposing the interior of the glomerulus, *a*. A short section of a capillary of the median group is removed to show the course of the deeper-lying capillaries.

Externally the upper half of the glomerulus is seen to be composed of freely anastomosing capillaries, somewhat more pronounced on the left than on the right side. The capillaries of the lower half, except on the posterior surface, are longer and more direct. The projecting loop of capillaries mentioned above, the course taken by the efferent vessel within the glomerulus, and the tendency of many of the external capillaries to turn towards the right side, give the glomerulus the appearance of being twisted to the right. Except on the superior surface where the left half is a little above the right, the spherical form is well preserved. Lobulation where it appears at all is superficial. (Fig. 1.)

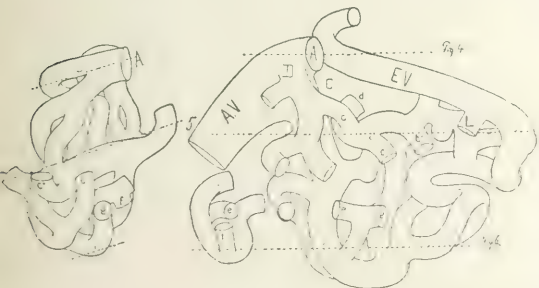


FIG. 3.—Diagram of the wax model seen from the left side. Enlarged 444 times. The right lateral group of capillaries is turned back from the main group. The group *E F* is a connecting loop turned over to expose deeper capillaries. The lines marked Figs. 4, 5 and 6 indicate that Figs. 4, 5 and 6 are taken from those planes, representing sections 7, 17 and 30 respectively of the original series.

The capillaries of the glomerulus can be roughly divided into a right, a left and a median group, corresponding to a right branch (Fig. 3 *A*), a left branch (Fig. 2 *B*) and a median branch (Figs. 2-3 *C*) of the afferent vessel. Two additional branches, a right lateral branch (Fig. 3 *D*) and a

left lateral branch (Fig. 2 *E*), take part in the formation of the lateral group of the corresponding side and of the median group. All five branches arise from the afferent vessel at the same time though at different angles. The distances between their points of origin are not the same. According to Ludwig, the glomerulus is composed of from 4 to 8 groups of blood-vessels.

Each main branch from the efferent vessel subdivides almost immediately. Each of the two lateral branches (*D* and *E*) has three subdivisions which are soon lost in the three main groups. They have in general the same arrangement.

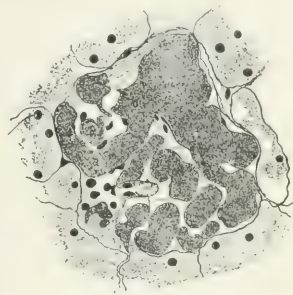


Fig. 4.

In the upper half of the left group (Figs. 1-2) there is a complex network of anastomosing capillaries. In the right group (Fig. 3), which is smaller than the left group and lies at a lower level, the course of the capillaries is more direct.

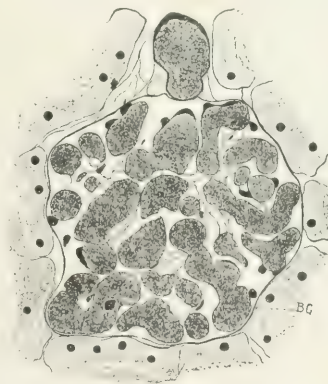


Fig. 5.

FIGS. 4, 5 and 6.—Camera tracings of sections 7, 17, and 30, showing the capillaries, reticulum nuclei and Bowman's capsule. Enlarged 444 diameters.

The capillaries of the median group nearest to and farthest from the origin of the median branch (*C*) are in general longer and freer than those of the other group. The intermediate capillaries are short and the anastomoses frequent.



In addition to the many connections between capillaries of the same group, the three groups or lobules are intimately connected with one another by numerous anastomoses. The capillary connections between the median group and the right group on one hand (Fig. 2) are of the same frequency, although unlike those between the left group and the median group on the other hand (Fig. 3). At one point there is an anastomosis of all three groups (Fig. 2 *d, d'*, Fig. 3 *d, d', d''*). The number and varied character of these connections show the impossibility of dividing the capillaries of the glomerulus completely into distinct groups.

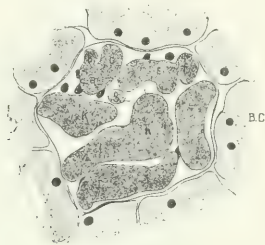


Fig. 6.

Through the divisions of the main branches of the glomerulus and their subsequent anastomoses, all the capillaries are concentrated at two distinct levels (Fig. 2 *F, G*) in the median plane opposite the afferent vessel. Though the formation of the efferent vessel is clearly indicated at each level in the sections, it cannot be said to actually originate until the last capillary from the glomerulus has united with it (Fig. 3 *L*).

It is seen that the blood in passing from the afferent to the efferent vessel has the choice of numerous paths of varying lengths. The shortest path is that from the right lateral branch of the afferent vessel just above the central point of the glomerulus and in the median line (Fig. 3 *D, c*). Passing outward from this point to the periphery of the glomerulus, the paths become longer and more complex. The longest path is that of the median branch and its subdivisions along the inferior surface of the glomerulus. It is three times as long as the shortest path (Figs. 2-3). Yet the shorter course is

zigzag and is composed of the smallest capillaries. As the course between the afferent and efferent vessel becomes longer and longer, the capillaries become straighter and larger, thus correspondingly favoring the blood circulation through them.

The afferent vessel is larger than its branches, especially just before the point of division; the branches are larger than their subdivisions. The efferent vessel is of the same size as the main branches of the afferent vessel. The increased diameter of the afferent vessel and its first branches is no doubt due to the pressure in the artery when the glomerulus was injected. Excluding this factor it is probable that the diameter of the various vessels of the glomerulus is the same from the afferent to the efferent vessel.

The very fine serial sections of the glomerulus not only served as a basis for the reconstruction of the blood-vessels, but also enabled me to study more carefully the relation of Bowman's capsule to the glomerulus. Ludwig\* has shown that the basement membrane of the uriniferous tubules is elastic and when treated with reagents is very likely to swell. Later Mall† showed by digesting frozen sections of various organs with pancreatin that the interstitial tissue and so-called basement membranes resolved themselves into fibrils, showing some characteristics of yellow elastic tissue, some of white fibrous tissue and some peculiar to themselves. This set of fibrils (reticulum) is widely distributed and makes up the main framework of the kidney. It is these fibrils of reticulum which form the basement membrane of Bowman's capsule.

As the afferent vessel pierces Bowman's capsule, the reticulum fibrils forming it separate as shown in Figs. 4 and 5. They are not reflected over the glomerulus, but, at the point of separation, fibrils arise which penetrate the glomerulus passing in all directions between its capillaries. The fibrils are densest at the point these vessels penetrate the capsule and gradually become less and less numerous as the periphery of the glomerulus is approached. Up to the present I have not determined the nature of these fibrils but on account of their arrangement as well as the connection with them of Bowman's capsule, I do not hesitate to class them with the other reticulum fibrils.

\* Ludwig, Stricker's Handbuch, 1871, p. 495.

† Mall, Abhandl. d. K. S. Ges. d. Wiss., Bd. 17, 1891; also Rühle, His's Arch., 1896, and Disse, Sitzungsber. d. Ges. z. Beförd. d. ges. Naturwiss. Marburg, 1898.

## MEDICAL COMMISSION TO THE PHILIPPINES.

It is matter of general belief that scientists in the retirement of the laboratory pursue their abstruse investigations oblivious of wars, revolutions, and the manifold variations in the phases of international politics, and it is, perhaps, well on the whole that there is some basis for the belief. But, as a matter of fact, it will be found that the trend of scientific research is, at times, enormously influenced by changes in the outside world; for with these changes new problems arise upon the solution of which depends the ultimate success of national undertakings. No more striking example of such

influence could perhaps be adduced than the extraordinary attention which is at present being paid to the study of the causes, prevention and cure of diseases prevalent in the tropics. While there have been, it is true, notable instances of medical research prosecuted with brilliant results in tropical fields in the past, it is only since Northern and Western nations have turned their faces resolutely towards the South and the East—faces stern in the determination to hold their own in the fierce international rivalry for conquest and control of trade—that the importance of the medical problems

of the hotter regions of the earth has begun to be fully appreciated, and that organized bands of skilled investigators have been sent into them to study the diseases to which a large mass of their fellow countrymen will henceforth be exposed.

The earlier observations on the conditions and diseases of tropical countries we owe to missionaries and explorers, men of roving instincts and venturesome habits, who partly in self-defense, partly from desire to benefit other travelers or the natives of the regions traveled through, observed the sick and examined the methods of treatment in vogue in those lands. All such studies were necessarily fragmentary and of a desultory character, but no one with a knowledge of the subject would speak of them disparagingly, for they represent the beginnings of an important movement, and have been, moreover, attended by valuable discoveries, some of which have proved to be of the greatest benefit to humanity. It is only necessary to mention the introduction of cinchona bark into Europe in the 17th century by the Jesuits, who had seen its beneficial effects in Peru, and to recall the immense part played by its alkaloid, quinine, in the treatment of malarial diseases to-day, to realize the significance of at least one of these discoveries. Millions of lives have been saved, and whole continents made accessible to civilization, for the dangers of forest and morass have largely ceased to be prohibitive since the white man has learned to carry quinine in his blood.

Later, white traders and white soldiers, the natural successors of missionary and explorer, on entering the tropical regions took with them civil and military physicians, who by virtue of their better medical and scientific training were able to describe climatic conditions, investigate the symptomatology of diseases, and study their causes, nature and treatment far more accurately than their predecessors had done. Thanks to their efforts we are already in possession of an analysis of the more prevalent diseases peculiar to the tropics and of the many facts of importance concerning etiology, pathology, prophylaxis and cure. Among the most fertile in results has been the work done by Fayrer in India, and in Cochin China by Calmette, on snake poison; in Algiers by Laveran, and in India by Ross, on the malarial infections; in Bombay by Vandyke Carter and Obermeier, on relapsing fever; in China and other countries, by Manson, on filariasis; and in the West Indies and South America, by Sternberg, Guitéras and Sanarelli, on yellow fever.

During the last thirty years, however, remarkable advances have been made in pathological and especially in bacteriological technique. A large number of scientific investigators in all civilized countries have been gradually overcoming difficulties which had hitherto been insurmountable, but which, by the new methods at their disposal could now be satisfactorily attacked. The field of medicine has become so wide and divided into so many departments that one man can scarcely hope to cover all of them. Much as we have to thank civil and military physicians in the past for the good work they have done, we can scarcely ask in the future men who have to devote a large share of their time to the treatment of patients and to the performance of executive functions to undertake the complicated researches necessary for the

isolation of the causative agent in obscure diseases. There has to be a division of labor and the practical man must be helped out by individuals who have been especially trained in particular lines of work, and who can give all their time to such work. Accordingly, of late, European governments and educational institutions have been sending into tropical regions men especially prepared and commissioned to investigate disease, and these men have been relieved of all duties except those actually connected with their original research. In this way, Koch and Gaffky went to Egypt and India, in 1883, to study Asiatic cholera, an expedition which resulted in the discovery of the cause of the disease; and at Hong Kong, in 1894, Yersin isolated the bacillus of bubonic plague. That such special investigations of the causes of disease justify the education of specialists and the expenditure of the time and money required is fully evidenced by the practical results which have followed. Cholera, now that the spirillum, the growth and activity of which in human beings cause the symptoms of the disease, is known and its habits of life and mode of dissemination have been studied, can in civilized countries be absolutely controlled; the disease can no longer gain a permanent foothold in a city in which modern methods of sanitation are employed. Plague which swept away whole populations at a breath in former times need now scarcely be feared among Western nations; for even if the hygienic precautions of the end of the century fail to keep the disease out of the West, the method of preventive inoculation which has been devised since the discovery of the causative bacillus will protect those who avail themselves of this prophylactic measure.

In the light of these facts the authorities of the medical department of the Johns Hopkins University decided in March of the present year to send two of their staff, Dr. Simon Flexner and Dr. Lewellys F. Barker, to the Philippine Islands, equipped with a complete outfit for the study of disease by modern clinical and pathological methods. They were instructed to study the diseases which prevail in the islands "with the hope not only of making contributions to the science of medicine, but also of being of service to the American forces in those islands, to the natives of the country, and to humanity at large." The expenses of the expedition were defrayed through the generosity of a few friends of the University. Two advanced medical students, Mr. Joseph Marshall Flint, of Chicago and Mr. Frederick P. Gay, of Boston, went as volunteers and at their own expense to assist in the medical work at Manila. Mr. John W. Garrett, of Baltimore, interested in the political relations of the archipelago, made a fifth member of the party.

The voyage out was made by way of Vancouver, Japan and Hong Kong. Ten days were spent in Japan and the experience there proved of great value as an introduction to the work in Manila, inasmuch as Japanese scientists have studied and, indeed, with considerable success, several of the problems which confront the investigator in the tropics. With Doctors Aoyama and Miura in Tokyo, several cases of *kokke* were observed, a disease which in the Philippines and in other countries, is more generally known under the name of beri beri.



The researches of the Japanese into the nature of this malady are among the most interesting and important extant. Dr. Aoyoma, who when investigating plague in Hong Kong was himself attacked by the disease and for a considerable period lay in a most precarious condition, showed no ill effects of the ordeal passed through, but was as active and enthusiastic as ever in the observation and treatment of disease. In the laboratory of Dr. Kitasato, the celebrated bacteriologist, of Tokyo, opportunity was afforded for looking into the work done by Dr. Shiga, one of the assistants in that laboratory, on the cause and treatment of dysentery. Dr. Shiga, who has isolated a bacillus which he regards as the cause of epidemic dysentery in Japan, has also, by inoculation of the bacillus into animals, prepared a curative serum which he believes will be of value in the treatment of human cases.

At Hong Kong, the members of the Commission, through the courtesy of Dr. Lowson, had their first opportunity of studying cases of bubonic plague, clinically in the wards of the isolation hospital and pathologically in the dead-house. The disease is constantly present there, though to a varying degree, among the Chinese inhabitants, Europeans being occasionally, though but rarely, attacked. A member of the Commission, speaking of experience with plague, remarked upon the curious mental phases passed through on encountering for the first time such a world-dreaded disease. During the first visit to the morgue in which the dead bodies of plague patients were kept, great care was taken to come into no personal contact with the dead, and even draughts of air leading from the vicinity of the cadavers were avoided. On the second day, the swellings (or buboes) in the groin, axilla or neck were palpated, but with some care; and on the third day, they found themselves making post-mortem examinations of the internal organs. Though Dr. Aoyoma developed the disease as a result of his studies, and Dr. Müller, of Vienna, died from plague contracted while attending a nurse sick of it, it is probable that pathologists, provided they take the necessary precautions to avoid infection, have less to fear than is ordinarily supposed. If one work much with the disease, however, he would be very unwise did he not take advantage of the protection afforded by Haffkine's preventive inoculation.

The members of the Commission arrived in Manila at the beginning of May and at once, thanks to letters from Surgeon-General Sternberg, and the courtesy of Colonel Woodhull, the chief surgeon of the American forces in the islands, were enabled to begin their work in the military hospitals there. The majority of the American sick in Manila are cared for in two large base hospitals known respectively as the First and Second Reserve Hospitals. In the former institution, with Major Crosby in control, are some twelve hundred patients; while in the latter, under the management of Captain (now Major) Keefer, there are perhaps one-fourth as many. As soon as the patients are convalescent, those who require further building up are sent to the pleasantly situated Convalescent Hospital on Corregidor Island. This hospital is situated on the shore snugly nestled beneath the fort which fired on Admiral Dewey's ships as he entered Manila Bay. In addition to the military institutions men-

tioned, there are numerous "district" and "regimental" hospitals in Manila, Cavite and other places where American troops are stationed. It was a matter of pleasant surprise to see how efficiently large military hospitals, seven or eight thousand miles away from home, could be organized for medical and surgical work. Whatever criticisms may have been made in America with regard to the administration of military affairs, nothing but praise is to be recorded of the medical services rendered by Colonel Woodhull and his staff in the Philippine campaign.

On account of the especial facilities and material obtainable at the First Reserve Hospital, working headquarters were established there, Lieutenant Strong generously sharing his laboratory with the newcomers, and in every way possible, lending his aid to the investigations undertaken. The time at their disposal being limited, the members of the Commission decided to choose, out of the many attractive problems which immediately suggested themselves for investigation, certain only which seemed to them of the greatest importance and which could be most advantageously approached. It was found that among the American soldiers in Manila the two most fatal diseases in May and June were dysentery and typhoid fever, while among the natives tuberculosis and beri beri were common and destructive maladies. The dysenteries and tropical diseases of the liver met with were made the object of especial study, and one of the most important results of the expedition was the isolation by Dr. Flexner, from the dejecta of patients, of a bacillus which is almost certainly the cause of the acute dysentery studied. The causative agent in this disease once known, it is perhaps not too much to hope that a preventive inoculation may be devised which will render individuals going to the islands immune from attack. Such a prophylactic measure if invented would be of incalculable value, since, according to an authoritative text book, "In the tropics dysentery destroys more lives than cholera, and it has been more fatal to armies than powder and shot." Malarial fevers are frequently encountered, and in Manila the parasites of the tertian and of the æstivo-autumnal variety are easily demonstrable in the blood of patients suffering from these types of the infection. The frequency and malignancy of the cases vary with the locality and with the season of the year. The deadly *calentura perniciosa* is much feared in certain districts, and as soon as the country is settled this form of malaria should be thoroughly studied. The forests of the interior of Mindoro and the regions adjacent to the Rio Agusan in Mindanao are localities of unusual interest in this connection. The relation of mosquitoes to malaria, so vital a question at the moment, is one well worthy of attack in the Malayan archipelago. Not uninteresting too, in passing, is the statement in certain of the Jesuitical records of Mindanao that the natives of that island recognized as far back as two centuries ago a relation between the intermittent fevers and the prevalence of mosquitoes.

At Cavite, an outbreak of some two hundred cases of beri beri among the Filipino prisoners yielded wide opportunity for the study of this disease in its various clinical and pathological aspects. In the same town a large epidemic of what was probably Dengue fever occurred.



The cases at the Spanish hospital of San Juan de Dios, those at San Lazarus, the leprosy hospital, and those at the city asylum, were made accessible to study through the kindness of Major Frank Bourns, of the Provost-Marshal's department. There were still a few smallpox cases in the city, though through the strenuous exertions of the officer mentioned, in the way of compulsory vaccination and the establishment of a *carabao* vaccine farm, this disease, which claimed so many victims from among the American soldiers at the beginning of the occupation, was practically stamped out of Manila. Skin diseases are very prevalent among the natives, and the affection known as *dhobie itch* (for the most part a form of ringworm) attacked large numbers of American soldiers.

A considerable amount of pathological material was collected by the members of the Commission especially from cases of *beri beri*, leprosy and dysentery, and this was brought back to America for further study. An abundance of plague material was similarly collected at Hong Kong. Bubonic plague does not exist in Manila, and a careful search through the older records would make it appear that it has never broken out in the Philippines.

The climate, though trying, owing to the continuous heat and moisture, is believed to be supportable if Americans will take certain necessary precautions. As one genial Englishman who has lived in Manila nineteen years, and who is now in perfect health, put it, "it is not so much the climate as the glass bottle which injures people out here." The visit of the Commission to the islands was made in the hottest season of the year, and at the beginning of July the onset of the rains by increasing the moisture in the air added much to the discomfort. However, if one carefully chooses his diet, eschews iced drinks, clothes himself rationally, avoids excesses both physical and mental, keeps out of the sun during the hottest time of the day, sleeps under mosquito-netting and does not bathe in too cold water, he may live a fairly comfortable life and will probably enjoy good health. Indeed, some Americans have found themselves in better health in Manila than at home, though this is the exception rather than the rule. Diarrheal troubles are very frequent and are to be combated by rest, a simple diet and, if necessary, by wearing a woolen abdominal band. Much has been written about the drinking of boiled water by the soldiers. Outside Manila this is certainly desirable, but any attempt to persuade soldiers on the march to follow this custom will probably prove futile. The Johns Hopkins party walked one afternoon from the Bag Bag river to San Fernando, and before the end of the journey found themselves drinking any water available, some of it certainly far from pure.

Early in July, Mr. Garrett left Manila for a trip through Java, and a few days later the rest of the party returned to Hong Kong, and began the homeward voyage which was made by way of Suez and London. Two members of the Commission spent three weeks in India, and there examined as fully as possible in the time, the outbreaks of plague which existed and the plague measures adopted by English officers in the Indian Empire. In Bombay, Colonel Weir, and in Poona, Major Reid and Major Windle accompanied them to the scene of the outbreaks.

The excursion to Poona was most impressive. Traveling upward for hours through the Western Ghats, the country was so beautiful and the air so much cooler than at the sea level, that one could scarcely believe that he was approaching, in the plain, a little lower down on the other side, the pest-stricken city of Poona. On arrival at the railway station, however, the first signs of distress were noticed. Train-loads of people were fleeing from the place. A drive through the town to the office of the chief plague authority showed how rapidly it was being deserted. Many of the streets were almost empty, shop doors and windows were closed and barricaded, plague notices were pasted on the wall, a preternatural stillness was everywhere noticeable, the few people encountered walking quietly along with heads bowed and faces sorrowful. A visit was made to some houses whence plague cases had just been reported with the native editor of the principal Poona newspaper, this gentleman having volunteered his services as plague inspector. In a small hovel, scarcely larger than a ship's cabin, one might find a patient surrounded by several of his friends awaiting the arrival of the inspector. The chances for contact contamination were manifold.

At the general plague hospital, there were some eight hundred cases of the disease under the charge of Major Windle. He was assisted by eight European nurses and a number of native helpers. He complained that it was almost impossible to retain natives as workmen; even washermen and grave-diggers could not be employed in sufficient numbers owing to the fears and prejudices of the people. Cartloads of the newly attacked were being brought into the hospital at its entrance, while a body was carried out from the wards every ten minutes to the morgue at the rear. Those who live in the West can scarcely appreciate the enormous disadvantages under which medical men fight plague in India. The people are ignorant and superstitious, the rigid caste rules prevent any successful application of modern hygienic measures, and even the preventive inoculation cannot be utilized to any great extent, owing to the fact that thus far the bacilli have been grown in beef-broth, and the natives will not countenance such a profanation of the sacred animal. Even in death, caste rules have to be observed, and it was found at the morgue that partitions had to be put up separating the low-caste Hindoos from those of high caste, from the Mohammedans and from the Parsees and Christians. The floor of the morgue presented a melancholy sight; in one of the rooms no less than thirty-two bodies lay upon the ground as closely packed as was possible without actually piling the bodies upon one another. Mohammedans are buried, and high-caste Hindoos are burned, but the bodies sometimes accumulate so fast that they cannot be disposed of by the usual methods. Major Windle stated that one day, a short time before, he had burned twenty-four bodies in one heap. It is absolutely impossible in Poona to employ occidental methods in the way of segregation or disinfection. The natives prefer to die rather than submit to rules which are obnoxious to them. It is no uncommon sight to see a widow, after uttering the death wail, beating her face and breasts and throwing herself violently upon the body of her dead husband, kissing his face and lips; it is very strange that no more than do contract the disease. One left Poona and

Bombay thankful that in America no such unfavorable religious and social conditions prevail.

Of the results which have been obtained by the Commission, it is too early as yet to speak more than generally. The observations made in Manila have to be supplemented and controlled by further microscopical and bacteriological studies upon the material collected. It will be some months at least before a full report can be looked for.

At present the observations concerning the causation of dysentery, the differentiation of the fevers of the region, the relative prevalence of typhoid fever and malaria, the studies of the varieties of the malarial parasite there found, and the investigations of beri beri, may be specified as among the more important scientific results of the expedition. The influence of the scientific spirit and methods, with the demonstration of their practical utility, so beneficial in medical centres at home and exerted at so early a period in the American régime in the Philippines, can scarcely fail to be of significance in the further development of medicine there.

It is probable that in the near future other expeditions will be undertaken as only a beginning in the study of tropical medicine has been made. England and Germany are alive to

the importance of such investigations. Major Ross has recently been sent to East Africa to continue his studies upon the part played by mosquitoes in the dissemination of malarial parasites, and Dr. Wright is being sent by the English government to establish a laboratory in the Malay peninsula for the study of beri beri. Prof. Koch, of Berlin, has also lately been sent on another expedition for the investigation of the malarial fevers in the tropics. Schools of tropical medicine are being established at various English and continental ports. The time seems ripe also for undertaking instruction in tropical diseases in America. The establishment of investigating institutes, and of teaching departments in such cities as San Francisco, New Orleans, Baltimore and New York, would be an additional safeguard to the country, since these are ports most likely to be infected. Moreover, careful instruction as regards diseases peculiar to the tropics and the special character assumed by other diseases when they occur in the hotter regions of the earth would seem to be essentials for those American physicians and surgeons who contemplate residence or practice in our tropical possessions.

LEWELLYS F. BARKER.

## AN APPARATUS TO AID THE INTRODUCTION OF A CATHETER OR BOUGIE.

By GEORGE WALKER, M. D., *Chief of Clinic out-door Surgical Department, Johns Hopkins Hospital.*

The accompanying cut is an apparatus which I have devised to facilitate the passage of a filiform bougie, or catheter, through a strictured urethra. The object of this instrument, is to distend the canal, and in this way to enlarge the narrowed portion, so that an instrument will pass through.

Fig. I (*a*) is a glass cylinder, the shape and size as seen in the cut, with three openings; the first (*b*) is to communicate with the urethra; the second (*c*) permits the entrance of oil from cylinder (*m*), Fig. III; the third (*d*) is for the reception of a rubber stopper carrying a catheter, or bougie; (*f*) is a pure rubber stopper, through the center of which is passed a glass tube (*g*); on the inner end of this is fitted a small ring of rubber tubing (*n*). Through this glass tube a catheter (*e*) is passed, and the rubber on the end is so fitted that it serves to prevent an outward flow of oil.

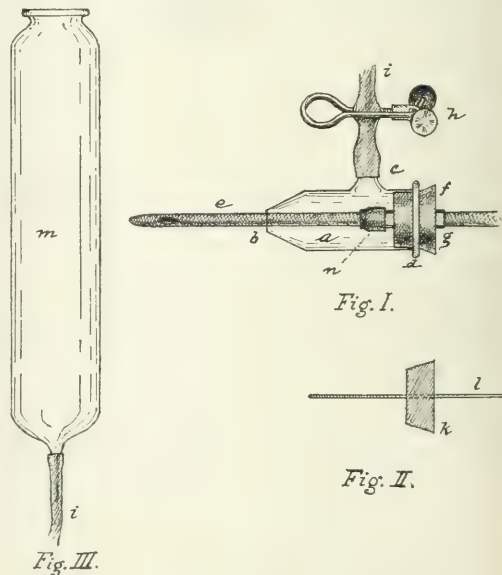
Fig. II is a rubber stopper similar to the above, with a very small opening through it, just large enough to admit easily the passage of a filiform bougie (*l*) and small enough to prevent the escape of oil or other fluid.

Fig. III (*m*) is a cylindrical glass vessel for the reception of oil; it is to be hung on wall and is connected with Fig. I, by a rubber tube (*i*) of varying lengths.

A rather stiff silk catheter should be used, as a soft-rubber one has a tendency to bend in the glass cylinder. The free end of the catheter is closed with a clamp or hard-rubber stopper, so as to prevent the escape of oil.

When required for use the cylinder (*d*) is filled with oil by slightly opening the pinch-cock (*h*); the end (*b*) is then introduced into the meatus and firmly held there by an assistant so as to prevent the escape of oil between the glass and

urethra. The catheter, or bougie, is then passed into the urethra as far as the strictured part; the stop-cock (*h*) is now



opened, and the oil allowed to flow in and distend the urethra. As this is being done the catheter, or bougie, is firmly pushed

inward, and as the walls are distended the stricture is slightly opened, and the instrument allowed to slip through.

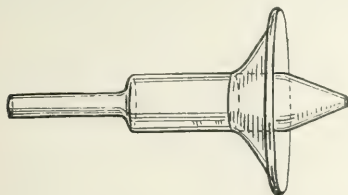


FIG. IV.—An Improved Urethral Irrigating Nozzle.

I do not say that by its use all urethrae can be made permeable, but certainly filiforms can be thus introduced in a num-

ber of cases which without it would be impossible, and catheters passed through diseased portions that otherwise would admit only filiform. Thanks are due Dr. Andrew Stewart, of Washington, for some suggestions.

Fig. IV represents an irrigating nozzle showing an addition to the ordinary straight nozzle in the form of a disc-shaped flange attached to the body near the urethral end. The disc serves to protect one's hands and other objects in the vicinity from becoming soiled by the fluids which are ejected from the meatus during irrigation. The straight nozzle which I have used resembles in some particulars those of Valentine and Young. The complete nozzle is made in one piece; it is simple, cleanly, small and entirely efficacious.

## SUMMARIES OR TITLES OF PAPERS BY MEMBERS OF THE HOSPITAL AND MEDICAL SCHOOL STAFF APPEARING ELSEWHERE THAN IN THE BULLETIN.

J. WHITRIDGE WILLIAMS, M. D. The Frequency of Contracted Pelves in the First Thousand Women Delivered in the Obstetrical Department of the Johns Hopkins Hospital.—*Obstetrics*, Vol. I, Nos. 5 and 6, 1899.

1. In our material, the frequency of contracted pelvis (13.1 per cent.) corresponds very closely with the general average of frequency observed in Germany.

2. This is due, in large part, to the presence of a large black population in Baltimore, 469 out of our 1,000 cases being colored women.

3. Contracted pelvis are 2.77 times more frequent in black than in white women, and occur in 19.83 per cent. of the former and 7.14 per cent. of the latter.

4. The statistics of Reynolds Crossen and myself indicate that contracted pelvis are observed in about 7 per cent. of the white women of this country, or about once in every fourteenth case.

5. Contracted pelvis, accordingly, occur in our white women about as frequently as in many German clinics, notably, Rostock, Breslau and Basel.

6. And occur quite as frequently as in Paris (Pinard and Budin) and more frequently than in Vienna.

7. As every fourteenth white and every fifth colored woman possesses a contracted pelvis, the necessity for routine pelvimetry becomes apparent.

J. WHITRIDGE WILLIAMS, M. D. A Case of Spondylolisthesis, with Description of the Pelvis.—*American Journal of Obstetrics*, Vol. XL, pp. 145-171; also, *Transactions of the American Gynecological Society*, Vol. XXIV, pp. 49-79.

In this article is described the pelvis obtained from a woman dying after a symphyseotomy performed on account of a pelvis contracted by spondylolisthesis. The smallest antero-posterior diameter of the pelvis, extending from the lower margin of the third lumbar vertebra, to the upper and posterior margin of the symphysis pubis, was  $6\frac{1}{2}$  cm.

The article is accompanied by numerous illustrations, which clearly illustrate the deformity, as well as its mode of production. This is the first American case which has been described anatomically, though such cases have been observed clinically by Blake, Lombard, Flint, Gibney and Lovett.

A full list of the literature on the subject accompanies the article.

J. WHITRIDGE WILLIAMS, M. D. Report of the Committee of the American Gynecological Society, of which Dr. Williams was Chairman, "On the Value of Antistreptococcic Serum in the Treatment of Puerperal Infection."—*American Journal of Obstetrics*, Vol. XL, pp. 289-314; and *Transactions of the American Gynecological Society*, Vol. XXIV, pp. 80-110.

I. A study of the literature shows that 352 cases of puerperal infection have been treated by many observers, with a mortality of 20.74 per cent.; where streptococci were positively demonstrated the mortality was 33 per cent.

II. Marmorek's claim that his antistreptococcic serum will cure streptococcic puerperal infection, does not appear to be substantiated by the results thus far reported.

III. Experimental work has cast grave doubts upon the efficiency of antistreptococcic serum in clinical work, by showing that a serum which is obtained from a given streptococcus may protect an animal from that organism, but may be absolutely inefficient against another streptococcus, and that the number of serums which may be prepared is limited only by the number of varieties of streptococci which may exist.

IV. Thus far the only definite result of Marmorek's work is the development of a method by which we can increase the virulence of certain streptococci to an almost inconceivable extent, so that one hundred-billionth of a cubic centimeter of a culture will kill a rabbit.

V. The personal experience of your committee has shown that the mortality of streptococcus endometritis, if not interfered with, is something less than 5 per cent., and that such cases tend to recover if Nature's work is not undone by too energetic local treatment.

VI. We unhesitatingly condemn curettage and total hysterectomy in streptococcus infections after a full-term delivery, and attribute a large part of the excessive mortality in the literature to the former operation.

VII. In puerperal infections a portion of the uterine lochia should be removed by Döderlein's tube for bacteriological examination, and an intra-uterine douche of four to five liters of sterile salt solution given just afterward. If the infection be due to streptococci, the uterus should not be touched again, and the patient be given very large doses of strychnia and alcohol, if necessary. If the infection be due to other organisms, repeated douchings and even curettage may be advisable.

VIII. If the infection extends toward the peritoneal cavity,



and in gravely septicemic cases, Pryor's method of isolating the uterus by packing the pelvis with iodoform gauze may be of service.

IX. The experience of one of the members of the committee with antistreptococcus serum has shown that it has no deleterious effect upon the patient, and therefore may be tried if desired. But we find nothing in the clinical or experimental literature or in our own experience, to indicate that its employment will materially improve the general results in the treatment of streptococcus puerperal infection.

HOWARD A. KELLY, M. D. A Curette for Cervical Cancer.—*American Journal of Obstetrics*, Vol. XL, 1899, p. 829.

The author has devised a toothed curette for the removal of redundant carcinomatous material in cases of cancer of the

cervix, which he considers much more satisfactory than any of the dull or sharp scoops now in use.

The instrument consists of a stout handle 9½ cm. long, a shank 1½ cm., tapering to an ovoid bowl which is 4 cm. long, 17 mm. wide, and 14 mm. deep. The essential feature of the curette is the series of crenations, each 2 mm. in height and 2½ mm. wide at the base, surmounting its blunt margin. These little teeth are very effective in removing the diseased tissue. A smaller instrument, two-thirds the size of the one described, is also used.

W. H. WELCH, M. D. Thrombosis and Embolism.—*Alburt's System of Medicine*, Vol. VII, 1899.

—The Material Needs of Medical Education.—*Journal of the Alumni Association of the College of Physicians and Surgeons*, Vol. II, No. 4, 1900.

## PROCEEDINGS OF SOCIETIES.

### THE JOHNS HOPKINS HOSPITAL MEDICAL SOCIETY.

*Tuesday, December 5, 1899.*

#### Exhibition of Surgical Cases.—Dr. MITCHELL.

We have to show three cases that have been treated in the service of Dr. Halsted, during the last few months, all traumatic and all having been serious accidents.

CASE I.—The first man, a miner, aged 28 years, was admitted in August with the history of an injury received 32 hours previously, having been crushed under a mass of falling coal. He was unable to walk after the accident on account of pain, though he had perfect motion of the limbs and could stand. He had retention of urine and was catheterized by a physician at the mines and the bladder was later aspirated. The urine obtained by catheterization contained a great deal of blood, but the aspirated secretion was clear. He was operated upon immediately after his entrance to the hospital.

On examination, the patient was unable to stand, the bladder was much distended, reaching almost to the umbilicus; the perineum was infiltrated with blood. A perineal incision was made, opening a cavity beneath the symphysis pubis, which was filled with blood clots and urine; the bladder still remained distended. A catheter passed through the meatus entered this cavity in the perineum, thus locating one end of the ruptured urethra. Suprapubic cystotomy was then done and retrograde catheterization showed the proximal end of the urethra, which had been ruptured just beneath the symphysis pubis. The urine in the bladder was perfectly clear. There was a fracture of the ascending and descending ramus of the left pubic bone, and a separation of the symphysis pubis. By attaching a piece of silk to a soft-rubber catheter, we were able to pass it through the entire course of the urethra. The urethra was not sutured because of the wide separation. A Bloodgood suprapubic tube was fixed in the bladder, and the perineal wound packed with gauze. The patient did very well. The bladder could be irrigated through the catheter and there was no trouble from infection. The catheter was allowed to stay in until September, when it was removed because blocked with salts, and a new one introduced. This was finally removed, nearly two months after the

operation, but the urethra still opened in the perineum. On October 23rd, the suprapubic tube was removed and the wound allowed to close, and from that time he has been voiding partly through the meatus and partly from the perineal wound, the latter having closed only within the last few days. The urethra has been dilated from time to time and a number 27 sound can be introduced with ease. He walks without evidence of trouble. The pubis is evidently firmly united.

CASE II.—This is a case of recovery after very great shock. The man was admitted ten days ago, about 6.30 p. m., in very bad condition and with the history of an injury to his right arm a short time before. He was working in a guano factory when his arm was caught in the machinery, and the forearm and hand very badly crushed. The skin of the arm was torn from the shoulder, down just as you would tear out the sleeve of a coat. His pulse was 80 and very weak, respiration 40, temperature 97.5°, and he was crying with pain and begging to have the arm taken off. He was immediately put to bed, the arm dressed with sterile gauze, the foot of the bed elevated and he was infused with 600 cc. of salt solution in the breast, and given ½ gr. morphia and a hot enema of coffee and salt solution. Up to 10 o'clock he improved, his pulse had become much stronger, he was quiet, his respiration slower and altogether he seemed better. After that time he began to go down again rapidly and there was considerable oozing from the dressings. He was in very bad condition when put on the table at 11 p. m., and though he was under ether only 10 minutes his condition became much worse during that time. He was given strychnia hypodermically and salt solution infusion during the operation. The foot of the table was elevated and his legs tightly bandaged. The operation itself lasted only 5 minutes. Dr. Bloodgood controlled the vessels by digital pressure in the axilla and the arm was amputated just below the shoulder. The vessels were quickly tied and the wound packed with gauze. At the end of this brief period, however, the radial pulse could not be felt, and the heart-sounds were so weak that the second sound could not be heard after the operation. The foot of his bed was kept elevated, he was infused again with salt solution and given

hypodermics of strychnia and morphia with hot enemata of coffee and salt solution. His condition remained very alarming during all that night, the pulse being rapid and weak, the temperature rising to 103.6° and he became delirious, attempting to bite and scratch the assistants. Towards morning, however, he became quiet and from that time on has made a rapid convalescence. The wound was inspected a few days after the operation and everything was found clean and in good shape. His blood-count has been somewhat interesting. The night of the operation it was practically normal, although there had been a great deal of hemorrhage—red corpuscles 5,000,000, leucocytes 23,000, and hemoglobin 70 per cent. Thirty-six hours later it showed reds 3,000,000, leucocytes 12,000 and hemoglobin 50 per cent.

CASE III. This case has been very interesting to us in connection with the question of nerve regeneration. He is a German, 38 years of age, and was admitted on the 10th of November with an injury of the inner and posterior part of the left arm, having been in contact with a buzz-saw. He was admitted in fairly good condition and kept quiet for two hours before operation, when he was put on the table and the arm cleaned very thoroughly. No anesthetic was used and although the operation lasted two hours or more, no bad effect was produced so far as we could see. There were three main cuts with numerous lacerations extending from them. The upper cut exposed the musculospiral and ulnar nerves and divided the internal cutaneous. The second cut divided the ulnar, made a large opening into the bone and divided the musculospiral just where it winds around the bone, while the third cut divided the median nerve just above the elbow, without exposing the artery. The triceps muscle was extensively lacerated and the ulnar nerve was hanging in this mass of lacerated muscle which was torn entirely from the bone at one point. The biceps was also partially divided and there was extensive laceration of the skin. We identified the peripheral portion of the nerves by pinching the ends slightly and getting a corresponding contraction. The central portions could be identified by pain when they were seized. A hasty examination for anesthesia was made and it was thought to be complete, but since then we find that we were mistaken. The nerves were sutured, the muscles brought together with buried silver and catgut sutures, and the skin approximated loosely over the wound. The man has made a perfect recovery and everything has healed per primam except the portions where there was no skin and these are covered by healthy blood clot. At the first dressing we found complete anesthesia of those portions supplied by the median, ulnar and musculospiral nerves. The only sensitive area was that supplied by the external cutaneous and some filaments of the musculospiral that came off above the injury.

#### DISCUSSION.

DR. THOMAS.—Was there any difficulty in bringing the ends of the nerves together?

DR. MITCHELL.—They were very far apart at the time, but we had no difficulty in approximating them and suturing without tension.

DR. THOMAS.—It will be very interesting to watch his recovery and note where regeneration first takes place, since all the nerves were completely divided.

AN IMPROVED STETHOSCOPE. DR. CABOT.—I have with me a stethoscope that I have used on about 40 cases a day for five months and which pleases me so much that I thought it worth while to bring it before you. It was invented by a gentleman in Boston, not a physician, who had seen the ordinary stethoscope and who thought he could make an instrument that would combine the advantages of this with those of the phonendoscope. It consists of a simple diaphragm of metal like that of the telephone connected with the chamber into which the tube of the stethoscope enters. It magnifies all sounds and it might be said to bear the same relation to the ordinary stethoscope that the high power of the microscope does to the low power. With it you can, I think, also hear sounds deeper in the chest than those heard with any other stethoscope. I have used it constantly for examination of the lungs and heart and find it exceedingly valuable for both. It enables you to hear cardiac murmurs, especially those of aortic regurgitation that can not be heard in any other way and this seems to me to be a point of great importance. The murmurs of mitral stenosis are not always, however, heard as well as with the ordinary stethoscope; that fact I can not account for.

A very obvious advantage of the instrument is that in listening to cases of pneumonia of the posterior lobes where the patient is very weak and you do not want to turn him, you can slip this flat edge under the back and hear the sounds with ease. I have known of an instance of a consultant being called from New York to Boston in such a case and feeling that he had not the right to turn the patient or raise him no examination of the lungs was made for two days. With such instrument as this such a delay could not occur.

I think also it is not an exaggeration to say that you can hear as much of the heart-sounds through the clothes with this instrument as you can with any other instrument next the skin. You should not listen to the lungs through the clothes, because the friction sounds of the clothes are so much like those of the lungs.

There are certain things that you can not do with it. If the patient has a very thin bony chest you do not get good effects, and it is not always good for very superficial sounds. I always carry the bell of the ordinary stethoscope to slip on for such cases. I don't think I should want the instrument alone without this arrangement, but I certainly should not want ever to be without this instrument again. I feel sure that any one who ever tries it will not give it up until something better is invented.

THE PULMONIC SECOND SOUND. DR. CABOT.—About one year ago, in reading Gibson's recent work on the heart, I noticed some observations concerning the second sound in health that disturbed me a great deal. I had always been taught that in health the pulmonary second sound was not so loud as the corresponding sound from the other side. Dr. Sarah R. Creighton went over one thousand cases



this summer in my clinic with reference to this point, throwing out all cases where there was anything wrong with the heart. She showed that in each decade, there is a rising percentage of aortic and a diminishing percentage of pulmonic accentuation as compared with the preceding decade. In other words, unless these one thousand cases are very deceptive, the accentuation of the aortic sound is a matter of age, the pulmonic sound being louder in the young and the aortic in older persons.

One other point that has struck me in the last two years in the examination of the normal chest is the presence in healthy persons of fine râles at the base of each axilla. If you listen in persons over 40 years of age, you will hear in a large proportion of cases these fine crepitant râles at the end of inspiration. They are heard over a very small area, frequently not larger than half the size of your palm. The explanation of this phenomenon is entirely dark to me. I thought it might be due to the formation of pleural adhesions, but I find it in connection with Litten's phenomenon so frequently that I can not see how that explanation can be accepted, so that I leave the observation as a purely clinical one without explanation.

#### BOOKS RECEIVED.

*Transactions of the American Surgical Association.* Volume the seventeenth. Edited by De Forest Willard, A. M., M. D., Ph. D. 1899. 8vo. XLI+319 pages. Printed for the Association, Philadelphia.

*Transactions of the American Orthopedic Association.* Thirteenth session, held at New York, N. Y., May 31 and June 1 and 2, 1899. Volume XII. 8vo. XXVIII+367 pages. 1899. Published by the Association, Philadelphia.

*King's College Hospital Reports; being the annual report of King's College Hospital and the medical department of King's College.* Edited by Nestor Tirard, M. D., F. R. C. P., et al. Volume V. (Oct. 1st, 1897-Sept. 30th, 1898). 1899. 8vo. XVII+270 pages. Printed by Adlard and Son, London.

*An Experimental Research into Surgical Shock.* An Essay awarded the Cartwright Prize for 1897. By George W. Crile, A. M., M. D., Ph. D. 1899. 8vo. 160 pages. J. B. Lippincott Co., Philadelphia.

*The Serum Diagnosis of Disease.* By Richard C. Cabot, M. D. 1899. 8vo. VII+154 pages. William Wood and Company, New York.

*The Principles of Bacteriology.* A practical manual for students and physicians. By A. C. Abbott, M. D. Fifth edition, enlarged and thoroughly revised. With 109 illustrations, of which 26 are colored. 1899. 12mo. XI+590 pages. Lea Brothers and Co., Philadelphia and New York.

*A Text-Book of Pharmacology and Therapeutics, or the Action of Drugs in Health and Disease.* By Arthur R. Cushny, M. A., M. D., Aberd. Illustrated with forty-seven engravings. 1899. 8vo. 730 pages. Lea Brothers and Co., Philadelphia and New York.

*A Practical Treatise on Fractures and Dislocations.* By Lewis A. Stimson, B. A., M. D. With 326 illustrations and 20 plates in monotint. 1899. 8vo. XIX+822 pages. Lea Brothers and Co., New York and Philadelphia.

*Transactions of the American Gynecological Society.* Volume XXIV. 1899. 8vo. XLVII+520 pages. Wm. J. Dornan, Printer, Phila.

*Transactions of the Indiana State Medical Society,* 1899. Fiftieth annual session held in Indianapolis, Indiana, June first and second, 1899. 8vo. 552 pages. Central Printing Company, Indianapolis, Indiana.

*Thirtieth Annual Report of the State Board of Health of Massachusetts,* 1898. 8vo. XXXIX+878 pages. 1899. Wright and Potter Printing Company, Boston.

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In the methods of instruction especial emphasis is laid upon practical work in the Laboratories and in the Dispensary and Wards of the Hospital. While the aim of the School is primarily to train practitioners of medicine and surgery, it is recognized that the medical art should rest upon a suitable preliminary education and upon thorough training in the medical sciences. The first two years of the course are devoted mainly to practical work, combined with demonstrations, recitations, and, when deemed necessary, lectures, in the Laboratories of Anatomy, Physiology, Physiological Chemistry, Pharmacology and Toxicology, Pathology and Bacteriology. During the last two years the student is given abundant opportunity for the personal study of cases of disease, his time being spent largely in the Hospital Wards and Dispensary and in the Clinical Laboratories. Especially advantageous for thorough clinical training are the arrangements by which the students, divided into groups, engage in practical work in the Dispensary, and throughout the fourth year serve as clinical clerks and surgical dressers in the wards of the Hospital.

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As candidates for the degree of Doctor of Medicine the school requires:

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 2. Graduates of approved colleges or scientific schools who can furnish evidence: (a) That they have acquaintance with Latin and a good reading knowledge of French and German; (b) That they have such knowledge of physics, chemistry, and biology as is imparted by the regular minor courses given in these subjects in this university.

The phrase "a minor course," as here employed, means a course that requires a year for its completion. In physics, four class-room exercises and three hours a week in the laboratory are required; in chemistry and biology, four class-room exercises and five hours a week in the laboratory in each subject.

3. Those who give evidence by examination that they possess the general education implied by a degree in arts or in science from an approved college or scientific school, and the knowledge of French, German, Latin, physics, chemistry, and biology above indicated.

Applicants for admission will receive blanks to be filled out relating to their previous courses of study. They are required to furnish certificates from officers of the colleges or scientific schools where they have studied, as to the courses pursued in physics, chemistry and biology. If such certificates are satisfactory, no examination in these subjects will be required from those who possess a degree in arts or science from an approved college or scientific school.

Candidates who have not received a degree in arts or in science from an approved college or scientific school, will be required (1) to pass, at the beginning of the session in October, the matriculation examination for admission to the collegiate department of the Johns Hopkins University, (2) then to pass examinations equivalent to those taken by students completing the Chemical-Biological course which leads to the A. B. degree in this University, and (3) to furnish satisfactory certificates that they have had the requisite laboratory training as specified above. It is expected that only in very rare instances will applicants who do not possess a degree in arts or science be able to meet these requirements for admission.

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# BULLETIN

OF

## THE JOHNS HOPKINS HOSPITAL.

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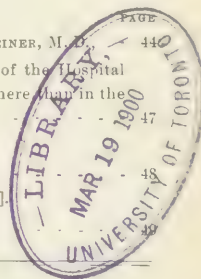
BALTIMORE, FEBRUARY, 1900.

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## REPORT UPON AN EXPEDITION SENT BY THE JOHNS HOPKINS UNIVERSITY TO INVESTIGATE THE PREVALENT DISEASES IN THE PHILIPPINES.

TO PRESIDENT GILMAN, DOCTORS WELCH AND OSLER,

*Philippine Committee of the Johns Hopkins University Medical School.*

Gentlemen:—We have the honor to submit to you a brief account of our work and movements in carrying out your commission to study the prevalent diseases in the Philippine Archipelago. Your commissioners, consisting of Dr. Simon Flexner and Dr. L. F. Barker, to whom were voluntarily attached Messrs. J. M. Flint and F. P. Gay, of the Medical School, the latter having given their time and paid all their own expenses, sailed from Vancouver on March 29th, 1899, and arrived in Manila, May 4th, where they immediately established themselves for the purpose of the work mentioned. Owing to the military situation it was found impracticable to visit other ports in the Archipelago or to penetrate into the interior of the Island of Luzon. The entire time of the commission, therefore, was spent in the study of disease existing among the natives and American troops in Manila and at Cavite.

### WORK IN JAPAN AND HONG-KONG.

As transport sailings were uncertain, and the passage out by them slow, it was decided to save time and go by fast steamer, the Canadian Pacific Railway giving special rates to the commission on tickets around the world.

The original plan of your commissioners was to proceed directly to Manila by way of Hong-Kong, at which latter port

it was intended to stop only long enough to outfit for the tropics and to catch the earliest steamer sailing for Manila. After consideration of the probability that certain new kinds or phases of disease, not occurring in temperate regions, might be encountered in the Archipelago, and of the fact that the diseases of the Philippines would probably have much in common with those of Japan, it was decided to spend one week in Japan, where modern hospitals could be visited and advantage taken of the results of the study of tropical disease by highly trained and eminent Japanese physicians. The decision proved to be valuable in many ways; and we especially desire to express our obligations to Professors Aoyama, Mitsukuri, Miura and Kitasato, who showed us many courtesies. The opportunity to see in the Japanese hospitals pure and mixed examples of beri-beri assisted us greatly in our subsequent studies, as did also the observations on dysentery made in the Institute for Infectious Diseases at Tokio.

While outfitting at Hong-Kong we improved the opportunity to study the bubonic plague, which was still prevailing at that port. This study was made easy by the generosity and courtesy of the English Civil Physician, Dr. James Lowson, in charge of the Plague Hospital and Mortuary. The study, begun in this way, was extended when two months later we returned to Hong-Kong, en route to America. At this time a considerable exacerbation of the disease had taken place, and within a week or ten days we saw several scores of cases and performed many



autopsies. The several forms of infection: inguinal, axillary, tonsillar, cervical and pulmonary, were thus encountered. Bacteriological examinations were made and tissues collected for future study. Two of the party (Dr. Barker and Mr. Flint) spent on the return journey three weeks (at their own expense) in India, where the great epidemics of plague there raging were observed.

#### ARRIVAL IN MANILA.

Immediately upon our arrival in Manila, quarters were sought at the "Hotel de Oriente." Very insufficient accommodations were secured for a limited time, as the sudden accession of families of Army and Naval officers had strained the hotel to its fullest capacity. Having been forewarned of the conditions of living in Manila, we took the precaution to bring with us from Hong-Kong a group of Chinese servants, intending to set up housekeeping if practicable. After much difficulty a small house was secured in San Miguel, where, by hiring parts of the furnishings and buying what could not be rented, a temporary establishment was secured.

Within a few hours after our arrival, the credentials and private letters brought were presented to Colonel Woodhull, Surgeon-in-Chief to the 8th Army Corps, and to General Otis. Colonel Woodhull afforded us every opportunity to prosecute our work in the military hospitals. Although no special introduction was in our possession, we quickly met Dr. Bourne, chief health officer of Manila, who opened to us the hospitals under his charge. Somewhat later we met Dr. Pearson, Chief Naval Surgeon, who opened to us the Naval Hospital at Cavite.

#### HOSPITALS IN MANILA.

*Civil Hospitals.* These consist of a large hospital within the walled city, *San Juan de Dios*. It has a capacity of from 250 to 300 beds, and accommodated, during our stay, both natives and Europeans. The number of European patients was small. When the military hospitals were much crowded a certain number of wounded prisoners of war were accommodated. The hospital contained chiefly native medical cases of both sexes. The *San Lazaro* or leper hospital, in the outskirts of Manila, contained from 80 to 100 lepers during our stay. These had come from Luzon, almost exclusively from Manila and its immediate surroundings. The two sexes are provided for in separate, large and airy wards. One wing of the building, having a private entrance, is devoted to native prostitutes who apply regularly for examination, and are incarcerated here and treated medically when found to be suffering from venereal disease.

*Military Hospitals.* These consisted, besides the regimental hospitals which were virtually detention camps, of three Reserve Hospitals—the 1st, 2nd and 3rd Reserve Hospitals; a convalescent hospital on Corregidor Island and the Hospital Ship *Relief*, which was anchored in the bay. The First Reserve Hospital, under the control of Major Crosby, had been originally the Spanish military hospital. It has been from time to time, by the erection of tents over platforms raised a foot or two from the ground, increased in capacity until in July it contained 1200 or more beds. The Second Reserve Hospital, under the control of Major Keefer, was a transformed

modern school-building, and because of its limited capacity (250 beds), high ceilings and wide corridors it made a model hospital. The Third Reserve Hospital had just been established towards the end of our visit, and was smaller than the others and intended as a convalescent hospital. The hospital at Corregidor is a temporary structure and intended for convalescents. It is especially well adapted for its purpose because of the high and hilly character of the island and its complete investment by the sea. The *Relief* was used as a hospital for acute cases; but some time before we left, the acute cases were transferred to the Reserve Hospitals, and the *Relief* sailed for San Francisco with invalided men.

The Reserve Hospitals accommodated especially American sick and wounded; but a ward in the First Reserve Hospital was set aside for the Filipino wounded.

After the outbreak of beri-beri at Cavite, a hospital under military control was established at San Roque in the remains of the Spanish Marine Hospital which had been wrecked by the insurgents.

*Naval Hospital.* A small hospital for sick seamen and marines was established at Cavite. Through the courtesy of Dr. Pearson this was open to us for clinical studies.

*Clinical, Pathological and Bacteriological Laboratory.* Through the kindness of Colonel Woodhull and of Major Crosby, the officer-in-chief of the First Reserve Hospital, a small Filipino house, situated on the banks of the Pasig, was given us in which to establish a laboratory. This was done on the second floor of the house. The expense of putting up worktables was kindly borne by the Medical Corps of the Army. The laboratory equipment was set up in this building, and within a very few days after our arrival work was begun. We desire to speak of the co-operation of the Medical Staff of the hospital who afforded us every opportunity to visit the wards, and many of whom joined or assisted us in clinical and pathological work. We wish especially to acknowledge the co-operation and assistance of Lieut. Richard P. Strong, a graduate of the Johns Hopkins University Medical School, who had on our arrival already begun to do laboratory work and who gave up much of his valuable time in furthering our interests. It was found unnecessary to establish laboratories in the other hospitals, in the first place, because all were connected with the First Reserve by the Signal Service telegraphic system of which we had free use; and next, because all the dead were carried to the morgue in conjunction with the First Reserve Hospital. We went or were frequently called to the other hospitals to make clinical and bacteriological examinations.

With few exceptions, all the dead were subject to autopsy. Post-mortem examinations were made at the Civil Hospitals upon natives, and at the Military Hospital upon all that died. Exceptions were made only in the cases of those dead from gun-shot wounds, when, if pressed for time, necropsies were sometimes omitted.

#### PREVAILING DISEASES.

The subject of the prevalent diseases may be considered as they affect (1) the natives, and (2) Europeans and Americans, especially the American garrison.

*Diseases affecting Natives.* (a) *Skin Diseases.* Of the skin diseases prevailing among the natives, aside from small-pox and other specific exanthemata, may be mentioned (1) diseases of the scalp, which are very frequent; (2) dhotie itch; and (3) an affection which resembles closely, and which is probably identical with, Aleppo boil (Delhi boil, Biskra button, *epidemische Beulenkrankheit*). (b) *Small-pox.* This disease has been so generally prevalent in Luzon that the natives have, to a large extent, lost fear of it. All evidence points to the greatest carelessness in preventing its spread during Spanish times. Isolation of the sick and disinfection of the habitations seem not to have been attempted; and vaccination, even among the Spanish garrison, had not been carried out. Under these circumstances it could be no surprise that after the American occupation the disease should appear and even become epidemic. The epidemic which appeared early last year was promptly met by Dr. Bourne, who caused the Spanish garrison still in Manila, and natives and Chinese within the city to be vaccinated. In order to insure satisfactory results he found it necessary to re-establish a vaccine farm in which young *carabao* were used for the preparation of the virus. Under the influence of this measure and by the aid of isolation of the sick, the disease had, in May, practically disappeared within the military lines about Manila. (c) *Leprosy.* A definite focus of this disease exists in Luzon. The cases, in the neighborhood of 100, which are confined in the San Lazaro Hospital, came from Manila and the country immediately surrounding that city. The disease affected both sexes, being more frequent in adults, although also present in half-grown boys and girls. The commonest forms were the tubercular and mutilating. Autopsies were performed upon several cases that had died during our stay. (d) *Tuberculosis.* Accurate statistics of the extent of the prevalence of this disease are difficult if not impossible to obtain. That the disease is a common one is indicated by several facts. It is frequently met with in the native hospitals, where it may have been recognized during life or is disclosed at autopsy. Many cases of supposed *beriberi* which we autopsied at San Juan de Dios proved to be tuberculosis. It is possible that the two diseases had co-existed, for we found such combinations freely recognized by Japanese physicians in the hospitals in Japan. Tuberculosis of the lungs was also found as a common complication in leprosy individuals that came to autopsy. Not very infrequent spectacles met with on the streets are much emaciated and weak natives affected with suggestive coughs and free expectoration. While it is not certain that these individuals were examples of tuberculosis, there is strong probability that this explanation of their condition is the correct one. (e) *Veneral Diseases.* Syphilis, by general agreement (statistics not available), does not prevail unduly. Chancroids and gonorrhœa are, on the other hand, very common. The majority of the prostitutes confined in the San Lazaro were victims of these two diseases. A very common complication of the soft sore, owing to lack of cleanliness, is swelling and suppuration of the inguinal glands. (f) *Beri-Beri.* This disease is well known among the natives. It would appear to be epidemic and endemic in Luzon. It is, judging from cases met with in San Juan de Dios Hospital and the statements of native phys-

icians, constantly appearing in a sporadic form. During our stay an epidemic appeared among the Filipino prisoners confined at Cavite. Some 200 cases developed in a few weeks; the mortality ranged from 20 to 30 per cent. The several recognized forms of the disease—edematous, paralytic, and mixed—were encountered. Clinical and bacteriological studies were made upon the living, and the dead were subjected to autopsy and bacteriological examination. The difficulty of getting to and fro between Manila and Cavite, on account of the impossibility of land communication, made this part of our work difficult and time-consuming. A considerable collection of pathological material and other data has been made. This material is now in process of study and arrangement.

*Diseases affecting Americans.* The chief causes of disability among American land forces are the enteric diseases. These are diarrhœa, dysentery, typhoid fever, and gastro-intestinal catarrhs. Many of the diarrhœas are merely preliminary to the symptoms of dysentery. Other infectious fevers are relatively infrequent. A small number of cases of scarlet fever and diphtheria only were encountered. The malarial fevers prevailed but not seriously during the months of May, June and July. (a) *Dysentery.* This disease is responsible for the greatest amount of invalidation and the highest mortality. It appears in acute, sub-acute, and chronic forms. The chronic form is sometimes attended by secondary abscess of the liver. The acute form may end in 24, 48, or 72 hours. In it the whole of the large intestine and usually the lower portion of the ileum are involved. The mucous membrane of the gut is swollen, congested and œdematous, in places hemorrhages have taken place into the mucous membrane, and the submucosa is swollen and its blood-vessels greatly dilated. No ulcers existed in such cases. Amoebæ were absent or very difficult to find in the fresh stools and in the intestinal contents immediately after death. In the sub-acute and chronic forms ulcers are present in the mucosa; the coats of the intestine are greatly thickened; at times large sloughs of mucous membrane, partly detached, occur, and the lesions are confined to the large intestine. Amoebæ are more commonly present in these cases, but are variable as to actual occurrence and numbers. Large hepatic abscesses, usually single, were encountered in a number of these cases. Amoebæ were variable in the contents of the abscesses. In one very large abscess, occupying both right and left lobes of the liver, no amoebæ were seen, but a pure culture of the *Staphylococcus pyogenes citreus* was obtained. The clinical study of the cases of dysentery with reference to amoebæ was equally unsatisfactory. In cases with marked symptoms both in patients confined to bed and those beginning to go about but still with persistently loose bowels, these organisms were frequently missed; while in instances ready to be discharged, they might, at certain examinations, be found to be very abundant. In morphology, the amoebæ studied corresponded with the amoebæ coli found in Egypt and in this country. The bacteriological study of cases of dysentery was carried out upon the fresh stools of acute and chronic cases, and with the intestinal contents, mesenteric glands, liver, etc., of cases dying and subjected to autopsy. The intestinal flora was studied in its entirety by means of plate cultures. Varieties of micro-organisms were separated.



Many of these were well-known species or occurred normally in the situations in which found. Tests with blood sera for agglutination were made, and those organisms giving positive reactions were separated for further study. Two groups of bacilli were thus differentiated: (1) Having affinities with the group of bacillus coli communis. The agglutination was variable, being constant and sensitive with the blood-serum of the same individual (host), and inconstant, and active in relatively strong solutions only, in serums from other individuals. (2) Having affinities with the group of bacilli of which the bacillus typhosus is the type. Agglutination was constant and sensitive with blood-serum of host as well as the sera of other individuals suffering from dysentery. Inactive with normal serum and serum from cases of typhoid fever, malaria and beriberi. A bacillus belonging to the second group, which is still under study, would seem to agree with the bacillus dysenteriae isolated by Shiga from cases of endemic dysentery occurring in Japan. It is regarded by us as an important factor in the causation of the dysentery of the Philippine Islands. Experiments in immunization of animals and the production of vaccine are in progress. (b) *Typhoid Fever*. The total number of cases of typhoid fever in the hospitals during May, June and July was far below that of dysentery; the number of deaths also was less. It was, however, a frequent affection among Americans. The examination of the blood, microscopically and with the Widal test, was of the greatest help in diagnosis. The disease came to autopsy presenting the classical intestinal lesions and also in atypical forms. In the small number of autopsies made upon those dead of this disease, several instances of slight intestinal involvement or even entire escape were met with. These cases would have remained very obscure or even undetermined except for the Widal reaction and bacteriological examination. In some instances the typhoid bacillus was found widely disseminated throughout the body, the autopsy being made immediately after death. (c) *Malarial Fevers*. A large proportion of the cases were sent in from the field and outlying military stations where examinations had to be hastily made, as instances of "malaria" or "intermittent fever" turned out to be cases of other diseases (typhoid fever, dysentery, etc.). A number of true cases of malarial fever were, however, met with, and in the blood of these the characteristic parasites, identical with those occurring in other places in which studies of the blood have been made, were found. No quartan parasites were met with, but cases of quartan affection doubtless exist. Typical infections with the "tertian" and "aestivo-autumnal" varieties of the parasite were encountered by us, and by microscopists among the Army physicians in the Reserve Hospitals and on the *Relief*. One of the fatal cases of malaria was complicated with acute lobar pneumonia. The cases of "calentura pernicioso" which occur in Mindoro, Mindanao and in certain parts of Luzon should be studied as soon as these regions are accessible. The Archipelago is favorable also for the study of the relation of mosquitoes and other insects to malarial infection. Some of the malarial cases were undoubtedly *recidivae*, imported from Cuba or elsewhere. A very small number of deaths were referable to malaria. Two instances of acute malarial infection came to us for autopsy.

On the other hand, several instances of malarial pigmentations of the organs, in persons dying from other diseases, were encountered. Parasites in the latter cases were absent. These men had, as a rule, been in Cuba or Porto Rico during the Spanish war.

(d) *Tuberculosis*. A number of cases of pulmonary tuberculosis developed among the soldiers in the American troops. A definite history of exposure to wet and various hardships was elicitable in many of these cases.

(e) *Dengue*. At Cavite there occurred a large outbreak of an epidemic fever of short duration (a few days), known locally as Cavite fever. Almost all who remained in Cavite for any length of time were attacked. Second and third attacks were common. Muscular pains were severe in some cases and not in others. A slight exanthem was present in many of the cases. Flushing of the face, restlessness and general malaise accompanied the fever and rapid heart action. Malarial parasites were not present in the blood, nor did the serum from such cases agglutinate cultures of the typhoid bacillus. The epidemic is regarded as one of Dengue.

(f) *Tropical Ulcers*. A number of the American soldiers suffered from a form of indolent ulceration, locally known as "tropical ulcer." These ulcers occurred singly sometimes, but were more often multiple. They began as small pustules, which gradually extended. They were most frequent among those who had been compelled to make long marches through swampy districts, and the patients themselves attributed the ulceration to "poisoning" in the marshes.

(g) *Wound Infection*. Our experience with wound infections was rather limited. The other problems undertaken, regarded as more important as bearing on the general question of disease and its causation in the Islands, left but little time and opportunity to attack this interesting subject. Certain observations of interest were made. Pyogenic infections due to the common pus cocci occurred. In a small number of gun-shot wounds causing compound fractures emphysematous gangrene occurred and the bacillus aerogenes capsulatus was isolated. In one instance of compound fracture of the tibia, a spore-bearing bacillus was associated with the bacillus aerogenes capsulatus. It was found in cover-slip preparations from the original wound and in the first set of cultures. It could not be further transplanted and hence was not identified. In two other cases was the bacillus aerogenes met with, one a case of peritonitis following infection of the intestine from an incarcerated hernia, and the other also a case of peritonitis but secondary to perforation of a typhoid ulcer of the intestine. The army surgeons were enthusiastic as to the adequacy of the "First-Aid Package" in limiting the number of wound infections.

#### CLIMATOLOGICAL AND HYGIENIC CONDITIONS.

The climate is that of continual summer. There is a wet season (S. W. Monsoon) and a dry season (N. E. Monsoon). The hottest period is at the end of the dry and the beginning of the wet season—precisely the period of our visit. The climate from November to March is said to be delightful. In the worst season of the year the climate is very trying, and especial precautions are to be taken if Americans are to keep







FIG. 1.



FIG. 2.



FIG. 2.



FIG. 3.



FIG. 3.

To illustrate Dr. Osler's Case of Malignant Gangrene in Malarial Fever.

well there. The extremes of temperature are not great, but the constancy of the high temperature, together with a high degree of humidity, makes the climate peculiarly enervating. We were interviewed at length while in Manila, officially by the U. S. Philippine Commission, with regard to climate and the hygienic precautions to be observed, as well as with regard to other medical problems in the Islands. The climatic conditions and the hygienic precautions to be taken will form the subject of a fuller report to be made later.

The above represents, briefly stated, the results achieved by your expedition sent to the Philippines. As will be patent to you, not a little yet remains to be done before the scientific portion of the work is completed. This portion of the report is for the present only hinted at or withheld until it shall have been finished. It is the intention of your commissioners to make careful studies of the material relating to beri-beri, dysentery, malarial and typhoid fevers, leprosy, and the bubonic plague, which has been collected. These studies, with the exception of that relating to dysentery, will be carried out upon preserved material, and the labor involved, which has been divided between Baltimore and Philadelphia, will necessitate that some time must elapse before the finished report is forthcoming. The task of completing the study of the bacillus isolated from cases of dysentery has been assigned

to Dr. Flexner, who was principally engaged with that theme during the residence in Manila. In order to carry out the experiments as designed, an outlay for experimental animals and their maintenance will need to be made. It is known to you that the original sum so generously contributed by friends of the University and appropriated for the use of your commission, has been exhausted, and that private means have been drawn upon to defray a part of the expense involved. We would respectfully draw attention to this fact and to the further expenses to be incurred, and request direction as to your wishes regarding these matters.

We wish to express our deep gratitude to Messrs. Flint and Gay, whose untiring efforts during our residence in Manila made it possible to accomplish far more than we could have done unaided. It is a pleasure to acknowledge also many kindnesses on the part of Mr. John W. Garrett.

That we are deeply indebted to the officers in the Medical Service of the U. S. Army and Navy for opportunities and aid, is evident from the report preceding. Courtesies and kindnesses extended by various citizens of Manila, European and native, are here also gratefully acknowledged.

Very respectfully,

SIMON FLEXNER,

LEWELLYS F. BARKER.

## A CASE OF MULTIPLE GANGRENE IN MALARIAL FEVER.

(WITH ILLUSTRATIONS.)

BY WILLIAM OSLER, M. D., *Professor of Medicine, Johns Hopkins University.*

There are three groups of cases of multiple gangrene:

(1.) *Raynaud's disease.*—There have been previous well-marked vascular disturbances in the extremities (syncope, asphyxia or hyperæmia), the gangrene is very often symmetrical, is usually slight in extent and limited to the fingers or toes, more rarely to the ear-tips or nose.

(2.) *Multiple spontaneous gangrene of limbs.*—In young or middle-aged persons, without any obvious cause, massive gangrene of one, two or three extremities occurs. Many illustrations of this are recorded in the literature.

(3.) *Multiple spontaneous gangrene in association with the acute infections.*—In measles, typhoid fever, typhus fever, scarlet fever, diphtheria and malaria, local gangrene may occur. There are multiple patches, not symmetrical, and the skin and subjacent tissues are more frequently affected than the extremities. While of course the phenomena of Raynaud's disease may occur as a sequence of any of the specific fevers, a large proportion of all the cases of local gangrene occurring during or after one of the fevers have nothing whatever to do with this affection.

The relationship between malarial fever and Raynaud's disease is believed to be very close. Many references are given to cases (a majority from French sources) by Barlow in his article in Allbutt's System, and more fully by Monro in his excellent monograph on the disease. (Glasgow, James Maclehose & Son, 1899.) Altogether, in the cases he has col-

lected, there were only 8.3 per cent. with malarious antecedents. I have looked over the notes of cases of Raynaud's disease which I have seen in Baltimore, nine in number, and I do not find malaria to be related as an etiological factor in any one of them, nor, so far as I know, in our very large series of cases of malaria during the past ten years has there been a single instance of Raynaud's disease.

The following case is a very remarkable illustration of multiple gangrene occurring in a case of æstivo-autumnal malaria. Similar cases have been reported in the literature, and are referred to by Monro in his monograph (page 96), but they seem to be exceedingly rare.

CLINICAL SUMMARY.—*Malaria when six years old—typhoid fever twice—last attack four months before onset of present illness—illness in the middle of October, supposed to be influenza, but more probably malaria—on November 2nd, onset of spots of gangrene in various parts—rapid extension—condition on admission as shown in the figures—complexion muddy—spleen enlarged—blood showed very many æstivo-autumnal organisms—temperature slightly elevated at first—subsequently no fever—rapid recovery.*

P. W. B., aged 23, bar-tender, admitted to Ward E, Thursday, November 29, 1899, complaining of sores on various parts of his body.

Family history.—Mother died of consumption. No history of rheumatism or of any special disorders of the skin.



*Personal history.*—As a child he had measles, mumps and whooping cough. When six years old he had malaria. Five years ago he had a very severe attack of typhoid fever, after which he had an abscess in the abdominal wall, which opened spontaneously and discharged for two months, leaving a large scar. He had at the same time many boils. Last year he went south with the Fifth Regiment, and in August he had a second attack of typhoid fever, and was ill for two months. He has had gonorrhœa twice; has never had lues. He has used tobacco freely; whiskey and beer in moderation.

*Present illness.*—The patient has been living in Baltimore this autumn, and has been very well until the middle of October, when he was ill in bed for nearly two weeks with pains in the back and general weakness; no fever, no chills, no herpes. The doctor called it influenza. The patient got up and was about for a few days, when, on November 2nd, just twenty-seven days ago, he noticed blebs about half an inch in diameter on both hands, which were slightly swollen. The next day a mottled area appeared on the instep of the left foot. It had a bruised appearance. A similar one appeared on the buttocks and on the dorsum of the right foot. Other spots came in the situation to be subsequently mentioned.

The hands and feet became very much swollen. The blebs broke and discharged a dark fluid; the skin around the affected areas was very red. There was no itching. He had some pain at night. Ten days ago he had slight chilly feelings. There had been no redness, nor swelling, nor blueness of the fingers or toes, and there had been no numbness or tingling. The urine had been clear. Dr. Fletcher made the following note on the day after his admission.

"The patient is a large-framed, well-nourished man; complexion rather sallow. The skin of whole body is pigmented, markedly so about nipple and umbilicus, to slight extent about genitalia; no increase in either axilla. The lips and mucous membranes are of fairly good color; no pigmentation of mucous membranes. Over dorsum of left hand, just behind knuckles, there are four whitish scars, the result of healing vesicles. Over the ring, middle and little fingers there is a brownish-yellow discoloration of the skin which is gradually peeling off where the blebs are healing. On palmar surface of same fingers the skin is raised in large blebs. The skin has a brownish-yellow color, and over the ring finger is quite gangrenous, and there is involvement of the subcutaneous tissue. The thumb and index finger are not involved.

"*Right hand.*—The dorsum of hand is unaffected. On the

dorsal surface of first and second inter-phalangeal joints of index, middle and ring fingers the skin is thickened, brownish in color, no vesicles. Over the hypotenar eminences on palm is a large area, measuring 5x6 cm., in which the skin is loosened from the subjacent tissue, markedly discolored, and at one point a serous fluid is exuding. The palmar surface of all four fingers shows a gangrenous condition of the skin with vesiculation and oozing of fluid, most extensive on ring finger, where the process invades the palm of the hand.

"*Right foot.*—Over dorsum of foot, below ankle, is an area, 5x3 cm., in which the skin is gangrenous and exceedingly black; slough still adherent to adjacent tissue; surrounding skin, slightly pigmented. Over the heel there is an area of brown, discolored, thickened skin, measuring 5x6 cm.; this area is sensitive to the touch.

"*Left foot.*—Below external malleolus is an area, 5x3 cm., of gangrenous and sloughing black skin.

"*Left buttock.*—Just over the spine at the junction of the dorsal and lumbar regions there is a patch of dry gangrenous skin 1½x2 cm. Over left gluteal region there is an irregular gangrenous patch, quite dry, measuring 4½x2 cm., slightly sensitive to pressure.

"*Occiput.*—Over the lower part of occiput, on each side, there are two areas in which the scalp has a gangrenous appearance, slight oozing of fluid causing matting of hair."

Though the history did not suggest malaria, as in the routine examination of the abdomen the spleen was found to be considerably enlarged, the blood was at once examined, and very large numbers of æstivo-autumnal organisms were found. The crescents were in unusually large numbers. Cultures taken from the blood proved negative. There was no leucoeytosis, and the differential count was practically normal. The eosinophiles were only 2 per cent. The patient was at once given quinine in full doses, and he began to improve rapidly. The larger sloughs were treated with linseed poultices made with bichloride solution. Crescents and ovoids persisted in the blood for some time, though by December 15th they were rapidly disappearing. On December 14th, the gangrenous patches on both hands had healed. On the feet the sloughs had separated, leaving deep ulcers, the sheaths of the tendons being exposed. The urine examinations were negative throughout. The patient had a slight rise of temperature (100°) at first; subsequently none at all. The figures from photographs, by Dr. Brownell, illustrate the condition on admission.

## BENJAMIN JESTY: A PRE-JENNERIAN VACCINATOR.

By THOMAS McCRAE, M. B., (*Thor.*), *Instructor in Medicine and Physician in charge of the Clinical Laboratory, The Johns Hopkins Hospital.*

"That a disorder communicated to the human animal from one of the brutes should protect the former against the contagion of small-pox, is one of the most interesting facts in the whole history of medicine. How glimpses of a truth so remarkable were first revealed to the casual observation of certain peasants, and how the result of this chance observation was gradually 'matured into a

rational and scientific form by a mind deeply imbued with the best principles of sound philosophy,' I have not leisure to tell you in detail."—(Watson's Practice of Physic.)

Tradition has it that there were many instances of the "glimpses" of the truth of vaccination referred to by Watson,

*Copy of print in the Fisher Collection at the Johns Hopkins Hospital.*



PAINTED BY M. W. SHARP.

ENGRAVED BY W. SAY.

TO THE PRESIDENT, VICE-PRESIDENTS, TREASURERS, TRUSTEES, AND  
MEDICAL OFFICERS OF THE ORIGINAL VACCINE INSTITUTION.

This Print of Mr. Benjamin Jesty, from a Picture in the possession of the Institution, is respectfully inscribed by their devoted Serv't,

WILLY SAY

Mr. B. Jesty, Farmer of Downshay, Isle of Purbeck, Dorset, who inoculated his Wife and Two Sons for the Vaccine Pox in 1774, from his Cows at that time disorder'd by the Cow Pox, and who subsequently, from the most rigorous Trials have been found ununsceptible of the Small Pox Having rationally set the Example of Vaccine Inoculation from his own knowledge of the fact of Ununsceptibility of the Small Pox after casual Cow Pox in his own person and in that of others; and from knowing the harmlessness of the Complaint. To commemorate the Accuracy of these historical truths the Vaccine Institution have presented this Portrait. *Extract from the Minutes of the Original Vaccine Institution, Broad Street, Golden Square, September, 1805.*

London, Published Decr 1st, 1805, by the Engraver, 22 No. 1, St. Marylebone. 1737 1816.





long before the great work done by Jenner. But the majority of these lack certain proof as cases of the employment of the inoculation of cow-pox as a preventive of small-pox. However, the evidence regarding the subject of this sketch seems thoroughly authenticated, and there can be no doubt of Jesty having performed vaccination in 1774. The date of Jenner's first vaccination was 1796, although for many years before he had been making observations regarding it. The material relating to Jesty has been very fully collected by Crookshank in his work on "The History and Pathology of Vaccination," from which much of my information is obtained. Jenner appears to have regarded the account of Jesty as an invention likely to detract from the credit due to himself. But it can in no way lessen Jenner's fame. The early instances were only isolated occurrences without influence further than their own surroundings, while Jenner introduced vaccination and gave it to the world.

Benjamin Jesty was born at Yetminster in Dorset, and was a farmer. Subsequently he moved to the farm of Downshay in the Isle of Purbeck, in Dorset, situated not far from Swanage. Judging from what has come down to us concerning him, he appears to have been an eccentric man, full of quaint ways of action and speech, but with a good share of the power of observation and of sensible reflection over what he had observed. In 1774, small-pox was prevalent in his locality. He was thought to be in no danger of it himself, having had the cow-pox previously by taking it casually from the cows. This was a matter of tradition through the countryside. Some of his family were not so protected, and the fact that two of his maid-servants, who had previously had the disorder from the cows, attended patients suffering from small-pox without infection, seems to have determined Jesty to inoculate the cow-pox into his own family as a preventive of small-pox. The farmer is said to have argued thus: "For his part he preferred taking infection from an innocuous animal like the cow, subject to so few disorders, to taking it from the human body, liable to so many and such diseases, and that he had experience on his side, as the casual cow-pox was not attended with danger like the variolous infection; and that beside there appeared to him little risk in introducing into the human constitution matter from the cow, as we already eat the flesh and blood, drink the milk and cover ourselves with the skin of this innocuous animal." (Extract from the communication of Rev. Dr. Bell).

Accordingly, Jesty carried out his ideas and inoculated his wife and two sons, aged two and three years, with the cow-pox. The patients went into the fields, and the virus was taken on the spot from the teats of the cows. A stocking-needle was the instrument used; Mrs. Jesty being inoculated under the elbow, the sons above. The latter had the disorder in a favorable way, but in the course of a week Mrs. Jesty's arm was much inflamed. She had fever, and was so ill that a neighboring surgeon, Mr. Trowbridge of Cerne, was called. He said "You have done a bold thing, but I will get you through it if I can." She soon recovered perfectly. Dr. Bell states that the boldness and novelty of the attempt produced no small alarm in the family and no small sensation in the neighborhood. Fifteen years later, in 1789, the sons were inoculated for the small-pox by Mr. Trowbridge, along with others who had not

had the cow-pox. At this time the inoculation of small-pox was a common procedure. The arms of the Jestys inflamed, but this soon subsided, and no fever or other variolous symptoms were observed. The unprotected individuals went through the usual course of inoculated small-pox. Subsequently Mrs. Jesty and her sons were often exposed to small-pox without taking it, while in 1805 one of the sons was inoculated for small-pox with a negative result.

It is a wonder, as Dr. Bell notes, that nothing of these cases was known to Jenner, as they would have been valuable evidence in support of his doctrines of the value of vaccination. But when one considers the means of communication of the day, it is easily understood why this experiment of a south-of-England farmer should have only become known to a very local district. Statements regarding these facts were drawn up in 1803 by Dr. Bell and Mr. Banks, the member for Corfe Castle, which is close by. These came before a committee of the House of Commons and the Jennerian Society. In 1804, the Society endeavored to get Jesty to come to London in order that they might see him and investigate the matter, but an attack of gout prevented. The following year the secretary of the society wrote:—

LONDON, July 25th, 1805.

Sir:—I am desired to propose to you that, provided you will come to town at your own convenience, but as soon as possible, to stay not longer than five days unless you desire it, for the purpose of taking your portrait as the earliest inoculator for Cow Pock, at the expense of the institution, you will receive 15 guineas for your expenses and the members of the establishment will be happy to show you any civility during your stay in London, on which account it is hoped you will be put to little or no expense.

I have the honor to remain, Sir,

Your obedient humble servant,

WILL SANCHO.

Mr. Jesty accepted the invitation and journeyed to London, taking one of his sons with him. It is stated that they met with great attention from the members of the Jennerian Society who were much amused by Jesty's ways. Some idea of his characteristics is given by various incidents reported. His family tried to induce him before coming to dress more fashionably, but he said "he did not see why he should dress better in London than in the country." Mr. Colson writes that on his return he gave a very unfavorable account of the metropolis, but said there was one great comfort there, viz., that he could be shaved every day. While there he was inoculated for the cow-pox, and his son for the small-pox, but neither took effect. This was done by the Society probably for the sake of their investigations. Mr. Jesty was presented with a pair of very handsome gold-mounted lancets, and his portrait was taken by Mr. Sharp; but he proved an impatient sitter, and it is said would only be kept quiet by Mrs. Sharp's playing on the piano for him. The portrait was presented to the Vaccine Institution, and is said by Crookshank to be now in the possession of Jesty's great grandson. There is an excellent copy of it in the Fisher collection of medical portraits in the Hospital.

The members of the Jennerian Society drew up a statement which among other things testified—"that Jesty had given decisive evidence of having vaccinated his wife and two sons in 1774, who were thereby rendered unsuceptible of the small-

pox as appears from their frequent exposure and inoculation. He was led to this from knowing the common opinion regarding the protection of cow-pox against small-pox and that he himself for the same reason was incapable of taking small-pox and from observation of the same thing in others. He believed that cow-pox was free from danger and that by it he should avoid various human diseases, such as the evil, madness, lues and many bad humors as he called them." The year after his visit to London, Jesty seems to have suggested an application for some pecuniary reward, but as the secretary of the Vaccine Institution considered any grant improbable, the matter was dropped.

Last summer, in company with Dr. Osler, a visit was made to the locality where Jesty lived. To-day, the ordinary native of the district does not know the name of Jesty. His farm, Downshay, is in the Isle of Purbeck in the county of Dorset. It occupies a delightful situation in a valley between the Purbeck Hills and Nine Barrow Down, a few miles from Corfe Castle. Leaving the Kingston road, the house is reached by a rough way through the fields with many steep descents. It is not seen at first, indeed we did not look for it, as our whole attention was centred on the superb outlook. To the left, in the setting sun, were the ruins of Corfe Castle guarding the gateway to the Isle of Purbeck; to the right, Swanage and its bay, with far off on the horizon the white cliffs of the Isle of Wight (The Needles); while across the valley was the fine sweep of the Nine Barrow Down. Encircled by trees and in a depression, we did not see the house until we reached the barnyard, when we were greeted by a jolly looking dairy-man who was just driving out his herd. The entrance to the garden was through a fine old stone gateway with pillars of a quaint design. The house was of a type common on the island, of two stories

and well built, looking very fresh and clean after its more than 250 years. The date of building, 1635, was carved on the side of the house.

From the farm-house, a drive of a few miles brings one to the village of Worth Matravers where Jesty is buried. This is situated on the point of land known as St. Alban's Head. Here, in the parish church, a picture of Jesty with a suitable inscription is found hung up in the vestry. In the church-yard adjacent is his grave with that of Mrs. Jesty alongside. His tombstone bears this inscription:—

SACRED  
TO THE MEMORY  
OF  
BENJ<sup>n</sup> JESTY (OF DOWNSHAY)  
WHO DEPARTED THIS LIFE  
April 16th, 1816  
Aged 79 years.

*He was born at Yetminster in this County and was an upright honest man, particularly noted for having been the first person (known) that introduced the Cow Pox by inoculation and who, from his great strength of mind, made the experiment from the cow on his wife and two sons in the year 1774.*

One feels that Jesty was in advance of his generation, and a man who saw probably better than he knew. He did his little to blaze out the path which has since become a highway. That he could do but little to advance vaccination, his circumstances decided. To another was the honor of giving vaccination to the world.

## HÆMOPHILIA IN THE NEGRO.

BY WALTER R. STEINER, M. D.

Although the disease hæmophilia appears to have been known since the time of Albucasis,<sup>1</sup> the great Arabian physician, yet the two, or possibly three, cases reported before Fordyce's<sup>2</sup> short article appeared, contain no real contribution to the study of this disease. In the year 1784, its hereditary character was pointed out by Fordyce. Nineteen years later the term "bleeder" was given by Otto<sup>3</sup> to those who had hæmophilia, and in addition to this he showed the general immunity of the females and their tendency to transmit the bleeding disposition to their offspring. Following these writers a number of American and German physicians did much in contributing to the knowledge of this disease. Schönlein<sup>4</sup> named it "hæmophilia" about 1828, and gave it a place in his text-book on "Pathology and Therapeutics." Its later history is closely associated with the name of the British physician J. Wickham Legg.<sup>5</sup>

The first attempt to collect all of the reported cases was made by Naas,<sup>6</sup> in Germany, in a paper published in 1820. He also endeavored to give a systematic description of the affection.

This work was followed by other statistical articles by Lange,<sup>7</sup> Grandidier,<sup>8</sup> and Dunn,<sup>9</sup> the last appearing in 1883.

Many cases have been reported among different races. The Anglo-Germanic race has furnished most of them, followed by the Latin, Scandinavian and Teutonic races. Individual instances have also been given by Heymann<sup>10</sup> in a Mohammedan family from Palembang, on the Island of Sumatra, where this diathesis was found in three generations, and by Koch<sup>11</sup> in a possible case of hæmophilia in a creole from Port of Spain, Trinidad. But in all the literature on the subject there is but one well-defined case in the negro mentioned.

This case was reported by Dr. Hadlock<sup>12</sup> before the Academy of Medicine of Cincinnati, on November 16, 1874. The patient was a mulatto boy, aged seven years, who was found, on the doctor's visit, to be bleeding from the mouth. On examination Dr. Hadlock considered the hæmorrhage due to a decayed snag of a tooth which had become loosened. The tooth was accordingly extracted with the result that the hæmorrhage became alarming in character. A compress steeped

in a solution of the persulphate of iron checked it for a time, but on the next day it seemed to be more violent than ever. The bleeding point was then cauterized and astringents were also given, all of which succeeded in arresting the hæmorrhage temporarily. It recurred again, however; all efforts to check it were in vain, and the boy died in forty-eight hours. "On inquiring into the history of the boy's family" Dr. Hadlock found "that many of its members had died from hæmorrhage from slight wounds. An uncle had cut himself with a scythe and died in consequence. His father had received a slight scratch from a briar and bled to death."

The following case, which was admitted to the Johns Hopkins Hospital on April 10, 1899, is consequently the second to be recorded in the negro race.

Alverta W., aged 14 years (Medical History, No. 9764), complains of hæmorrhage from the nose and mouth, and headache.

*Family history* (obtained mostly from patient's mother).—Father, mother and two brothers, alive and well; a sister died of throat trouble, aged 6 years. No history of tuberculosis, rheumatism, or any neoplasm in the family.\*

*Hæmophilic history.*—Patient's great-grandmother was a bleeder from early childhood till her death, June 8, 1898, from old age and la grippe. Her doctor frequently told her the bleeding was due to the fact that she had "too much blood." Patient's mother (Alverta S.) says she can distinctly remember the doctor coming about twice a year to remove some of this "too-much blood," by cupping or leeches. The great-grandmother had fourteen children, ten boys and four girls. Of these, the patient's mother remembered the names of eleven only, seven boys and four girls. (See family tree.) The seven known personally to the patient's mother were all of them bleeders, and are now all dead but William T. One of the sons, Mose, died from hæmorrhages from the nose and mouth in 1895, in Philadelphia, at the age of thirty-four years. He had had hæmorrhages from early childhood, but during his last five years they were more severe. The doctor told his wife he did not have consumption, but what diagnosis was made of the case is unknown. The patient's grandmother used to bleed from the nose occasionally. She died December 30, 1898 (aged 60), of "asthma, dropsy, Bright's disease and heart disease."

Patient's mother frequently bled from the nose till her sixteenth year. She has had no attacks since.

Patient's brothers have occasional attacks of epistaxis, and bleed considerably from the slightest cuts and bruises.

*Past history.*—As a child, had measles, mumps and whooping cough. "Ulcerated sore throat" of two weeks' duration

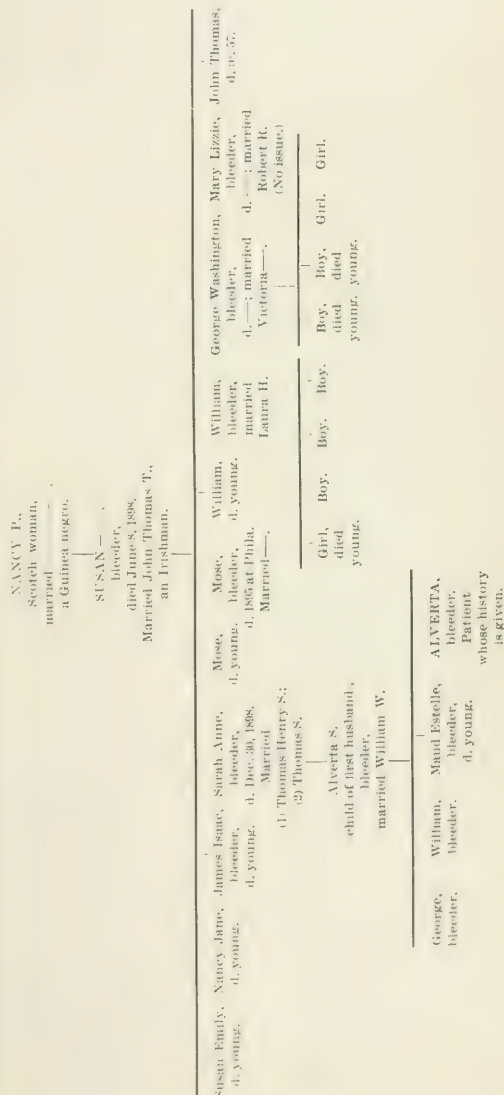
\* One brother, William W. (Surgical History, No. 9080), was later admitted to the Johns Hopkins Hospital, on the surgical side, complaining of a swollen right ankle. He gave the history of an attack of gonorrhœa one month previously. The swelling in the ankle seemed located in the tissues about the joint, there being apparently no effusion in the joint itself. The diagnosis of gonorrhœal arthritis was made. Patient left the Hospital July 2nd, against advice, being only slightly improved. In view of the occurrence of joint troubles in hæmophilia, added interest is given to this case.

one year ago. She gives a somewhat indefinite history of malaria in the spring of 1896. No chills, but thinks she had chilly sensations and fever. Was living in Baltimore at the time.

She has been a sufferer from severe frontal headaches ever since she can remember.

Menstruation has not yet been established.

*Hæmophilic history.*—Has bled easily from the slightest scratches since early childhood, but the amount of blood lost





has been very slight in every instance. No attacks of epistaxis till present illness.

*Present illness.*—About two and a half months ago, she woke up one morning and found her pillow and night-dress bathed in blood, which came from her nose. By eating some salt, she checked the hæmorrhage after she had bled about a cupful. Since then she has not enjoyed her customary good health, but has felt very weak and drowsy. Five days prior to her admission to the Hospital, she was awakened by an attack of epistaxis. It started with a sudden gush of blood, but soon amounted to only a slight ooze, and so continued for three days. Salt was also used on this occasion, but to no purpose.

Two days after this, she found she had had her third nose-bleed, during the night. It was very slight, however, and she was not awakened by it. In all, she thinks she lost about "half a wash-basin of blood."

Her only symptom in these attacks has been constant frontal headaches.

No bleeding from, or swelling of her gums, has ever been noticed, nor has any blood ever been detected in her urine or fæces. On admission, temperature, 100.4°; pulse, 104; respiration, 24.

*Physical examination.*—Patient is a quite well-developed, dark-skinned negro girl. Lips and mucous membranes are rather pale. Her tongue has a reddened, glazed appearance. The gums are swollen, and inflamed, but no bleeding points can be seen, nor can the gums be made to bleed on pressure.

*Thorax.*—Negative on examination. Pulse 100 to the minute, regular in force and rhythm, good volume and tension.

*Abdomen.*—Negative.

*Extremities.*—Negative.

No petechiæ or purpuric spots seen anywhere.

Blood examination negative for malarial parasites. Leucocytes, 10,500. The day following admission, a small herpetic area was noted on her lower lip. The nose examination was negative. Four purpuric spots, about 2 mm. in diameter, were seen about the right clavicle.

*Blood examination.*—Coagulation time, between 3-4 minutes;

red blood corpuscles, 5,088,000; white blood corpuscles, 4,500; hæmoglobin, 60 per cent.; blood platelets, 212,000.

On the third day a few additional purpuric spots were seen about the flexor and extensor surfaces of both arms and legs, at the elbows and knees. For the past two nights there has been slight bleeding from her gums.

On April 14th, the following note was made by Dr. Fletcher: Patient's gums are still distinctly swollen, but less so than on admission. They bleed easily on pressure.

Seven days later the gums were considerably less swollen, and could not be made to bleed on pressure. At the time this note was made, patient had been up and about the ward for four days.

*Blood examination,* April 23.—Red blood corpuscles, 5,020,000; white blood corpuscles, 6,000; hæmoglobin, 47 per cent.; blood platelets, 280,000.

The patient improved wonderfully during her stay in the Hospital, and was discharged April 24th. No more petechial spots were noted after those seen April 12th, and those then seen quickly vanished.

*Urine.*—On entrance the urine was straw-yellow in color, clear, 1021 in specific gravity, faintly acid in reaction, negative for sugar, but contained a trace of albumen. There was a white flocculent precipitate. Microscopically a few hyaline and granular casts were seen as well as a number of epithelial cells, and calcium oxalate crystals. Mucous strands were also seen. The urine gradually cleared up, and on the last examination (April 21), no casts nor albumen were found. Her temperature nine hours after admission rose to 101.2°, but gradually fell till the next day, when it was 99.8°. From this time on there were daily elevations, the highest point reached being 100.7° on April 14th.

*Treatment.*—Patient was given calcium chloride (grs. xv t. i. d.), a drug which was first introduced by Wright<sup>13</sup> for the treatment of this disease. It was given in the following prescription, as advised by Wright:

R	Calci chloridi,	-	-	-	ʒiii.
	Aquæ chloroformi	-	-	-	ʒii.
	Aquæ aurantii florum,	-	-	-	ʒiv.
	Aquæ q. s. ad.	-	-	-	ʒvi.
	M. S. ʒss. t. i. d. p. c.				

It is interesting to note that both the cases of hæmophilia were not in patients of pure negro blood.

In a study of the family tree of the second case we find:

(1) The extraordinary fertility of bleeder's families (a fact first pointed out by Wachsmuth<sup>14</sup>) is well shown in the family of our patient's great-grandmother. Five of her children died early, and none of the others, save one, now survives.

(2) Of these, three children out of the six known to patient's mother died young. This accords with the fact that a large percentage of the bleeders die early.

(3) Contrary to the usual statement, both the males and the females seem to have been bleeders, but only one (a male) died from the effects of hemorrhages.

(4) The preponderance of the males is seen in two of the families named. This excess of sons over daughters has been given as a reason for the rarity of this disease.

(5) The bleeding tendency in each instance was transmitted through the females.

In conclusion, I wish to thank Dr. Osler for allowing me to report this case.

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## SUMMARIES OR TITLES OF PAPERS BY MEMBERS OF THE HOSPITAL AND MEDICAL SCHOOL STAFF APPEARING ELSEWHERE THAN IN THE BULLETIN.

ROBERT L. RANDOLPH, M. D. Acoin: A New Local Anæsthetic.—*The Ophthalmic Record*, Chicago, August, 1899.

Acoin in solutions of 1:100 and 1:300 produces satisfactory anæsthesia in an unirritated eye in about the same length of time as cocaine.

2. In more than one case where the eye was congested, repeated instillations of acoin were inadequate to produce satisfactory anæsthesia.

3. Inspection of the cornea with a high-power lens failed to show any defects in the epithelium after its use.

4. Acoin has no effect upon accommodation.

5. It has no effect upon the size of the pupil.

6. It does not increase the intra-ocular tension.

7. Several experiments demonstrated that the staphylococcus pyogenes albus did not grow in agar which contained acoin in the proportion used in the clinic, and, furthermore, that exposure of this organism to the action of acoin for twenty-four hours was followed by death of the organism. This would look as though acoin were not only an inhibitor of the growth of this organism, but that it also killed this organism after a certain length of time. It is evident that conclusions drawn from this limited experience with acoin may have to undergo more or less modification with further trial.

— Expulsive Intra-ocular Hamorrhage after Preliminary Iridectomy for Cataract.—*The Ophthalmic Review*, London, December, 1899.

The case reported was an old lady of 76. She was exceedingly nervous and refused to enter the hospital, but preferred remaining at home and being nursed by members of her own family. From the uniformly favorable results attending preliminary iridectomy for cataract, this operation was first performed with intention of removing the lens a few weeks later. The operation was perfectly smooth. On the morning of the third day, it was found that the anterior chamber was almost completely obliterated, and that the lens was pressed so far forward as to force the iris against the posterior surface of the cornea. The condition grew worse, till the lens was almost forced through the old wound, when it was thought best to remove the lens. This was done and immediately there was a flow of bloody vitreous. Oozing kept up for four days. Light perception was gone, and in six months the eye had shrunk to half its original size. Six months later glaucoma appeared in the other eye. She was unwilling for iridectomy, and with the history of the fellow eye it was thought best not to urge such a measure. The development of glaucoma in this eye justifies us in concluding that the same condition was present, in a less advanced stage, in the right eye at the time of the preliminary iridectomy. The case is of exceptional interest inasmuch as the hæmorrhage followed iridectomy, for, as a rule, such catastrophes are seen only after removal of the lens. It is interesting to note the fact that intra-ocular bleeding did not commence till hours after the iridec-

tomy. The nature of the trouble was not suspected till the morning of the third day, when the evidence of pressure behind the lens was unmistakable, so that bleeding must have been going on intermittently for days before the lens was removed. The constant reduction of intra-ocular tension caused by the yielding of the eyeball at the point of the wound would explain the persistent character of the hæmorrhage. It is needless to add that we undoubtedly had in this case senile degeneration of the blood-vessel walls—so strong a predisposing cause to such results.

F. H. VERHOEFF, Ph. B., M. D. Shadow Images on the Retina.—*Psychological Review*, January, 1900.

The usual pin-hole experiment is produced by pricking a small hole in a card, which is then held before the eye, but within the point of distinct vision. Under these conditions, if a pin is held between the hole, which serves as a source of light, and the eye, it casts an erect shadow upon the retina, and this shadow is projected as an inverted image of the pin. This experiment was described and explained by Le Cat in 1740. It is possible, however, that he was not the first to describe it, for he does not, in his work, claim that the experiment was original with him.

To show the dependence of the position of the projected image upon the relative position of the pin-hole, the experiment may be modified in the following interesting way. If, for instance, the eye is focused for the near point and the pin-hole is held beyond this point, the shadow of an interposed pin will appear erect. Under these conditions, if the pin-hole is gradually brought closer to the eye, the image of the pin becomes more and more blurred and finally disappears when the hole is at the near point, that is, when the eye is accommodated for the source of light. If the hole is brought still nearer, the original experiment is reproduced, the image of the pin again appears but is now inverted. This experiment is rendered easier if the accommodation is assisted by a convex lens, one of about ten diopters being very convenient. The lens is held close to the eye and the pin in front of the lens, or better, immediately behind it. Then if the pin-hole is placed beyond 10 cm. from the supposedly emmetropic eye, it will appear out of focus and the shadow will be upright. As it is brought closer, the phenomenon just described takes place.

If a sheet of white paper or a piece of ground glass is taken, and a small black spot is made upon it about the size of a pin-head, and this spot is used in place of the pin-hole in the above experiment, a white streak will be seen crossing the black spot. The phenomenon is best obtained without a lens, and is not an easy thing for most persons to see, since it requires that the accommodation shall be relaxed at will. This white shadow behaves in exactly the same manner as does the black shadow in the pin-hole experiment—under the same conditions it may be seen upright, inverted, or be made to disappear. The experiment should be conducted in a good light, and a piece of white paper about five centimeters square should be used. This phenomenon may also be obtained with a photographic camera.

The explanation of this phenomenon lies in the fact that the black spot, under the conditions mentioned, produces only a blurred image upon the retina, and while the interposed pin reduces the illumination of the margins of the spot, it has no appreciable effect upon the middle of the latter, the resulting difference in illumination thus producing the appearance of a white streak.

If a sufficiently large spot is used, it will be noticed that on relaxing the accommodation, the center (of its image) appears much darker than the rest of the image. This is due to the fact that as the spot is made larger it cuts off more and more rays which otherwise would have reached the center of its image, and when it is as large as the pupil, it cuts off all the rays parallel to the primary axis, thus producing a small spot in the center of its image totally devoid of light. But even when the spot is much less than half the size of the pupil, the image appears darker in the center, since many rays will even then be cut off from the center of the image. This circumstance explains the fact that if a moderately large black spot is used for the shadow experiment, the white shadow of the pin is broken by a dark central spot into two white lines, somewhat resembling crescents. If a large black spot with a small white one in the center is used, the appearance of these two crescents may be obtained, and in addition the usual black shadow is seen over the central white spot.

If, in place of a spot, a black line is used, the pin will produce a white line running down the middle of its image; the shadow in this case is more marked and more easily obtained than when a small black spot is used. Two lines drawn at a slight angle to each other, will give a bend in the white shadow at their intersection, but the shadow leaves one or both of the lines at a certain distance from this point. When a narrow red line is used instead of a black one, and a lens is employed to aid the eye, the white shadow takes on a greenish or bluish color. By the use of a lens a narrow line may be so blurred as not to be seen, but a pin in front of the eye decreases so much the amount of light reaching the lateral portions of the image on the retina, as to produce the appearance of a well-defined white shadow. The same thing is also true for a point.

Scheiner's experiment in which two pin-holes placed close together are held before the eye and a double image of a pin is produced, may be explained in the same way as the white shadow just considered, since the two images obtained of the pin may be regarded as one image with a white shadow down its middle produced by the portion of the card-board between the two pin-holes.

When simply blurring a line by relaxing the accommodation, it can be noticed that if the line is not too large, one can always

obtain a white line running down its middle, and within this line a faint dark line. In the case of a small black spot, a white spot is obtained in the center of its blurred image. This is probably due in most part to the denser and probably less transparent nucleus of the crystalline lens shutting off more rays than the rest of the refractive apparatus of the eye. This appearance is not produced by a photographic camera and hence must be mainly due to some such peculiarity of the eye as that suggested. It is possible, however, that the positive aberration of the eye may play some part in its production.

THOMAS R. BROWN, M. D. Recent Work in Typhoid Fever.—*Maryland Medical Journal*, January, 1900.

ARTHUR W. ELTING, M. D. The Antitoxin Treatment of Tetanus.—*Albany Medical Annals*, January, 1900.

T. CASPAR GILCHRIST, M. D. Progress in Dermatology.—*Maryland Medical Journal*, January, 1900.

WILLIAM G. MACCALLUM AND THOMAS W. HASTINGS, M. D. Acute Endocarditis caused by *Micrococcus Zymogenes* (Nov. Spec.), with a Description of the Micro-Organisms.—*Journal Experimental Medicine*, September-November, 1900.

WILLIAM OSLER, M. D. The Home Treatment of Consumption.—*Maryland Medical Journal*, January, 1900.

— A Rhode Island Philosopher (Elisha Bartlett).—*The Boston Medical and Surgical Journal*, January, 18 and 25, 1900.

STEWART PATON, M. D. Certain Essential Points in the Technic of Staining Nerve-Cells.—*Philadelphia Medical Journal*, January 13, 1900.

ROBERT REULING, M. D. Pathology and Bacteriology.—*Maryland Medical Journal*, January, 1900.

WILLIAM R. STOKES, M. D. Recent Advances in the Study of Tuberculosis.—*Maryland Medical Journal*, January, 1900.

HUGH H. YOUNG, M. D. Recent Reports on the Operative Treatment of Hernia.—*Maryland Medical Journal*, January, 1900.

## PROCEEDINGS OF SOCIETIES.

### THE JOHNS HOPKINS HOSPITAL MEDICAL SOCIETY.

#### Exhibition of Medical Cases.—DR. FUTCHER.

During the past three or four months we have had a number of interesting cases of embolism and thrombosis in the medical wards. A brief report of these cases may be of interest.

CASE 1. Thrombosis of the left external jugular subclavian and axillary veins, associated with mitral stenosis, with subsequent embolism of the left popliteal artery.

One of these cases was referred to, at a previous meeting, by Dr. Welch when speaking of thrombosis of the veins of the upper extremity associated with heart disease. The patient, a woman aged 35, had had an attack of chorea when seven years

old, and previous to admission had several attacks of acute articular rheumatism. There were marked signs of mitral stenosis with a rapidly-acting heart and cardiac hypertrophy. The first point of interest in the case was the development of some swelling over the left side of the neck, first seen on January 19th, 1899, two weeks after her admission. She complained of slight pain in the left side of the neck and down the inner part of the arm. The pain and swelling gradually increased, so that within a week there was very marked swelling over the left side of the neck, shoulder, arm and dorsal surface of the fore-arm. There was marked tenderness over the sterno-cleido-mastoid muscle and along the course of the external jugular vein. There was no special elevation of temperature



du ing the attack. There was no doubt that the patient was suffering with thrombosis of the external jugular vein and, also, apparently, of the subclavian and axillary veins.

Thrombosis of the peripheral veins in cardiac disease is more common in the upper than in the lower extremities. According to Bouchut, the ratio of thromboses of the veins of the upper extremity to those of the lower is placed at 1 to 50, but in cardiac disease the ratio is decidedly reversed. Dr. Welch was only able to find 26 cases in the literature of venous thrombosis of the peripheral veins in association with heart disease, and of those, 17 were in the veins of the neck or upper extremity, and it is interesting to note that the left side is much more frequently involved than the right.

To return to our case, by March 13th all the local symptoms had subsided and nothing of special importance developed until November 24th, 1899, when, at 12 o'clock, the patient suddenly complained of intense pain in the left foot, associated with a feeling of the pricking of pins or needles and some numbness. I was in the ward at the time the pain came on, and examined the foot, but nothing could be made out by the examination. The pain continued very severe during the afternoon, and at 4.30 P. M. the foot and leg still showed no changes on inspection. The next morning there was marked cyanosis of the left lower extremity as high as the tubercle of the tibia; the foot was cold, and there was great tenderness over the dorsum of the foot and about the shin. Dr. Osler saw the patient and made a diagnosis of embolism of the popliteal artery. The femoral artery pulsated, but there was no pulsation of the popliteal. The next day, November 26th, contrary to expectations, the cyanosis had largely disappeared, and the foot had become almost as warm as that of the other side. From that time on the symptoms gradually subsided, though she still has paroxysms of acute pain at times. The point of interest in connection with the case is the recovery without local gangrene. A great many of these cases result in gangrene of some portion of the extremity. In embolism of the arteries the onset of pain is usually very sudden, differing in this respect from thrombosis, where the pain is more gradual in its development.

CASE 2. Thrombosis of the left femoral vein in a case of pulmonary tuberculosis. This condition is not so very uncommon in tuberculosis, usually occurring in the veins of the lower extremities. The patient, a man 55 years of age, was admitted Oct. 22nd, with marked signs of advanced pulmonary tuberculosis. About two weeks after admission, he began to complain about midnight of severe pain in Scarpa's triangle. The next morning his leg was definitely swollen, being 3 cm. larger than the other leg at the calf. The superficial veins were distinctly dilated, and the temperature on that side was, if anything, a little higher than that of the other leg, though there was no change in its color. The pain persisted for about ten days. The swelling has gradually diminished, and at present there is a definite thickening to be made out along the course of the femoral vein. Thrombosis in tuberculosis is generally held to be due to the development of marantic thrombi. Dodwell and others think that they are of infectious origin due to various pyogenic micro-organisms. Arterial thrombosis in tuberculosis is a rare event. It occurs most commonly as a thrombosis of the pulmonary artery or its branches in tuber-

culosis of the lungs. Very rarely it occurs as a result of tuberculous involvement of the intima of the arterial walls.

CASE 3. Thrombosis of the right axillary and brachial veins, occurring in the course of a malarial nephritis. The patient, a man aged 39 years, was admitted Oct. 16th, 1899, suffering from malarial nephritis. He had a marked amount of albumen in the urine, with numerous casts. He was distinctly anæmic, showing less than 3,000,000 red blood corpuscles, and about 50 per cent. of hæmaglobin. *Æstivo-autumnal* malarial parasites were found in the blood. On Oct. 18th, it was noticed that the right arm was somewhat swollen, and this condition increased during the next three or four weeks to such an extent that it was deemed necessary to make incisions in the skin to let out the fluid. Considerable relief followed this procedure. The swelling eventually diminished, and, although suspicion was entertained of a venous thrombosis, it was not until the œdema had markedly disappeared that a marked thrombosis of the right axillary and brachial veins was found to exist.

Just what the cause of the thrombosis was in this case is hard to say. It is doubtful whether malaria had anything to do with it. French observers have claimed that malaria does, at times, cause a thrombosis of the veins, but Dr. Welch is inclined to believe that there is really no relationship between the malaria and the thrombosis in these cases. In over 2000 cases of malaria in Dr. Osler's department, no instance of thrombosis was found. It is probable that the thrombosis in this case was due either to the nephritis or to the anæmia.

#### NOTES ON NEW BOOKS.

Annual and Analytical Cyclopædia of Practical Medicine. By CHARLES E. DE M. SAJOUS, Philadelphia. (*Philadelphia: The F. A. Davis Company, 1899.*)

This is the fourth volume of the publication and includes subjects from "Infants, Diarrhoeal Diseases of," to "Mercury." In a work of this kind a uniform excellency is not to be expected, but in this volume the editor is to be congratulated on the general high character of the articles. The task set is no easy one—to embody much in small space, and to make satisfactory extracts from large numbers of articles. The editor notes in the preface the death of one of his associates, Dr. Rohé of Baltimore, who contributed the article on "Insanity" in this volume. It is one of his last contributions.

The volume opens with an article on "The Diarrhoeal Diseases of Infants," by Dr. Blackadar, of Montreal, which is full of practical points. The sections on classification and treatment are especially good. "Intubation of the Larynx" is treated of by F. E. Waxham of Chicago. This is an excellent paper and especially so in its practical character. We should like to draw attention to this feature which is often lacking. Too rarely do writers bear in mind that those who will profit by their articles have had little or no experience in the subject discussed. Details which to the experienced writer seem trivial or unnecessary are really the essential parts for the reader. Dr. A. McPhedran of Toronto, contributes two excellent articles on "Jaundice" and on "Diseases of the Liver and Gall-Bladder." He has succeeded in giving much matter in small space, and has made very comprehensive selections from the literature. The longest article is that on "Malarial Fevers" by Drs. J. C. Wilson and T. G. Ashton of Philadelphia. They have given a very full account of the disease and of the latest

investigations as to the manner of infection. The plates used to illustrate the parasites are those of Mannaberg's recent work.

It is not possible to refer to all the articles in detail; those of W. B. Pritchard of New York on "Locomotor Ataxia" and of C. M. Hay of Philadelphia on "Meningitis" are worthy of notice. Altogether this volume is an excellent one.

A Text-Book of the Practice of Medicine. By J. M. ANDERS, M. D., Philadelphia. Third edition. (Philadelphia: W. B. Saunders, 1899.)

The appearance of a third edition of this work shows that there was ample room for it. Many of the articles have been rewritten for this edition and some added. The author pays considerable attention to diagnosis and gives many differential diagnosis tables. We are unable to agree with him as to the value of these. We refer not particularly to these of Dr. Anders, which are good, but to the general principle. Students are too apt to attempt to memorize them, thinking it an easy path to knowledge, only to discover later that their labor has become sorrow. In discussing cardiac diseases he evidently considers the apex diastolic, or so-called Flint murmur, in aortic insufficiency as of rare occurrence, and dismisses it in a few lines. The widely divergent views as to the frequency of this murmur are interesting. The section on "Chronic Valvular Disease" is especially well-put and practical. We should hardly consider "astolic pulsation of the larynx and trachea" as a good description of Oliver's tracheal tugging. It is surprising to find no mention of eosinophilia in the discussion of trichinosis. Throughout the book the sections on treatment are full, comprehensive and practical, which is a most valuable feature.

The Medical Annual Synoptical Index. For the twelve years, 1887 to 1898. (Bristol, England: John Wright & Co., 1899.)

This is an index to the contents of the Medical Annual for the years 1887 to 1898. To those who know this work it will be evident to what a large amount of material this index is the key. In addition to its being an index, it also contains many briefly-put extracts regarding new drugs and points of treatment. In the synoptical index these are put in various subdivisions under each heading. By these any special point is readily found. The notes on treatment embody much in small space. A summary of the chief changes in the new pharmacopoeia is a valuable feature. There is also a supplementary index giving many cross references. The general plan of the book is excellent, and it cannot fail to be of great help to the busy practitioner. In these days of profuse medical literature, an index such as this is always of assistance.

Bacteriology in Medicine and Surgery. By WM. H. PARK, M. D., Assoc. Professor of Bacteriology and Hygiene, Univ. and Bellevue Hosp. Med. College, New York. (Philadelphia and New York: Lea Bros. & Co., 1899.)

Amongst the large numbers of publications appearing every year, dealing with the subject of bacteriology for the use of medical practitioners and students, it is noticeable that the many are of doubtful helpfulness, whilst the lesser numbers only are of real service to the classes which they were intended to benefit.

It is therefore from amidst the latter sort that we single out the work by Dr. Park as worthy the attention of our readers.

It consists of an introduction dealing in an excellent manner with the history of bacteriological science, followed by forty chapters which treat of the general morphology of bacteria, their vital phenomena and their relation to disease, and the biological features of the most important pathogenic varieties; the theories of infection, immunity and recovery; the principles and practice of disinfection; the methods of procuring material for examination; the technique of staining and cultivating the bacteria; and the analysis of air and water. Inclusive is an appendix descriptive of patho-

genic forms of the higher fungi, formerly classified with the bacteria.

Friendly criticism being healthful, we shall briefly deal with the failings as well as the good features of the book.

The subject matter of the chapters descriptive of the general characteristics, morphology, vital phenomena and environments of bacteria, is extensive and so lucid that the reader very readily grasps the various facts set forth. It is only to be regretted that the author did not see fit to have chapters VIII, IX, and XVII incorporated with, or made to follow chapters I, II, and III, as the sequence is undoubtedly marred by the present arrangement.

In like manner, the valuable material in chapters IV, V, VI, and VII, dealing with the relation of bacteria to disease, infection, immunity and recovery, would undoubtedly have been placed to better advantage had chapters IV and VII been combined, and chapters V and VI formed another.

The technique of mounting, staining and examining bacteria is plainly stated in chapter XII.

Chapter XIII deals with the usual methods of preparing media, the technique of inoculating and making plate cultures, and the methods of anaerobic culture. There are an unfortunate obscurity and lack of arrangement in that part dealing with the making of plate cultures, otherwise the chapter is free from faults, though somewhat terse.

A most welcome message is expressed in chapter XV. For what worker in a large laboratory has not at one time or another been greatly annoyed by the display of ignorance by those submitting specimens for examination.

One prominent feature of the book is the treatise on disinfection contained in chapters X and XI. Here we have Dr. Park's valuable and wide experiences in this one matter of Public Health, strongly and succinctly stated; and a careful perusal of these chapters amplifies one's knowledge very considerably. For in most textbooks dealing with bacteriology these important points of practical disinfection are too often passed over hurriedly, or not mentioned.

Another feature worthy of comment is the ample and thorough manner in which the chapters dealing with the biological features of the various organisms, are discussed. Especially would we draw attention to those descriptive of tuberculosis, diphtheria, typhoid fever, pneumonia, gonorrhoea, cholera, glands and rabies.

Notwithstanding some occasional obscurities in grammatical construction, and what we have considered as shortcomings, Dr. Park's work can be considered as of valuable assistance to those of the medical profession and its students, who stand in need of reliable information and help in pursuing their studies in the important subject of bacteriology.

The book is gotten up in excellent style, being printed upon good paper with clear type, and is well supplied with suitable engravings and half-tone photographs of many of the well-known bacteria.

N. MACL. H.

Diseases of the Nervous System. By LUDWIG HIRT. Translated by A. Hoch, M. D., and F. R. Smith, M. D. (New York: D. Appleton & Co., 1899.)

The first English translation of this work appeared in 1893, and from the present title-page it appears that this is in no sense a second edition, but merely a reprint of the first edition; that is, that no essential changes have been made in the text either by the author or his translators, since the book was first published in America.

In the past ten years since the author published his volume first in Germany, the advances in neuro-pathology have been enormous, but though we know so much more of the finer anatomical structure of the whole nervous system, yet we are by no means able to use all this accumulated knowledge either in the diagnosis or treatment of



nervous diseases, and it is for this reason that the work under discussion only appears as a reprint and not as a second edition.

But the value of the work is thus in no wise diminished, and as a guide to the study of nervous diseases Hirt's treatise ranks as one of the very best both for the student and specialist in this line of work. The intrinsic merits of the work are clearly set forth in the introduction by Osler, who quotes Weir Mitchell's praise of the book, and the reviewer feels that when two such leaders of medicine unite in commendation of a work, this is the best review that the book can have.

Although the study of nervous diseases is one of the hardest in medicine, yet the style of the author is so clear and easy, that it is a real pleasure to read his volume; which cannot be said of most German works, even when they are so well translated as is here the case. Hirt may fairly be compared with Strümpell in the lucidity with which he writes, and his novel arrangement or description of diseases has a very distinct attraction for the reader, which the reviewer finds makes the study of nervous disorders more comprehensible than is sometimes the case.

The illustrations are excellent, there is a good index, and both type and paper are satisfactory.

**Archives of Neurology.** From the Pathological Laboratory of the London County Asylums, Claybury, Essex; Edited by FREDERICK WALKER MOTT, F. R. S., M. D., F. R. C. P., Director of the Laboratory, and Pathologist to the London County Asylums; Physician in Charge of Outpatients, Charing Cross Hospital. (*Westminster: P. S. King & Son, 1899.*)

The tendency toward an increase of laboratory work in connection with neurology and psychiatry in England and America is obvious. While in Germany and in Paris the association of microscopic studies of post-mortem material with careful clinical work in neurology and psychiatry has for a number of years been a prominent feature, England and America have been slower to adopt the plan. Of late, however, vigorous efforts have been made to bring psychiatry in English-speaking countries up to a higher level. The establishment of the pathological institute in New York in connection with the asylums of the state of New York, and the development of a laboratory at the Ohio Hospital for Epileptics, together with the excellent laboratories connected with several Massachusetts institutions—the McLean hospital, Worcester hospital and Danvers hospital,—are notable results of such efforts. Other asylums for the insane and institutions for the care of epileptics and the feeble-minded are rapidly making arrangements for the institution of well-equipped modern laboratories in connection with them.

The publications of the results of studies from such laboratories are beginning to appear. The Bulletin of the Ohio Hospital for Epileptics and the Archives of Neurology and Psycho-pathology from New York are well known to our readers. These, together with the results of research published in Asylum Reports are practically the only representatives in America of a class of publications quite common in Germany. Obersteiner's *Arbeiten*, Wernicke's *Arbeiten*, Pick's *Beiträge*, Henschen's *Studien*, Möbius' *Beiträge*, Kraepelin's *Arbeiten* and other examples will be immediately called to mind.

One of the most important of the more recent laboratory establishments is that in connection with the London County Asylums. The London County Council has authorized the building of a laboratory in connection with the asylum at Claybury in Essex, and has equipped it well for scientific work by modern methods. Autopsies are made at all the asylums, but the laboratory at the Claybury institution is the headquarters for the working up of the tissues. The Council has been fortunate enough to secure as director of the laboratory and pathologist to the asylums, Dr. Frederick Walker Mott, well known in this country as well as in Europe for his important researches in the experimental physi-

ology and pathology of the nervous system. At the end of 1899, Dr. Mott has published a large volume entitled "The Archives of Neurology," which includes the more important researches made in the laboratory by himself and others during the past year. The Archives are to be published annually, and will thus contain the collected papers dealing with the pathological work of the London County asylums.

The first volume includes some twenty-four papers, ten of which bear the editor's name. The papers are all interesting, and a number of them are of unusual importance. Dr. Mott's studies on "Brain Syphilis," on the "Etiology and Pathology of General Paralysis," on "Juvenile General Paralysis," and on "The Chemistry of Nerve Degeneration," must be studied with care by all who are more than superficially interested in the problems to which these titles refer. Dr. Hamilton Wright contributes valuable papers upon "The Tangential System of Fibres of the Inferior Frontal Convolution in General Paralysis," on "Alcoholic Atrophy" and, in connection with Dr. Mott, upon the "Changes in the Spinal Ganglia and Peripheral Cutaneous Nerves in a Case of General Paralysis with Bullous Eruption." One of the most interesting casuistic reports is that by Dr. Mott dealing with the spinal cord, peripheral nerves and muscles in a case of acute poliomyelitis in which the fatal termination occurred sixteen days from the onset. The sensory ganglia in tabes have been studied by Mr. Salaman. Dr. Barratt describes the results of his observations on the normal anatomy of several cerebral nerves, and also on the amount of water and phosphorus contained in the cerebral hemispheres and spinal cord in several pathological conditions.

The volume is printed upon heavy paper, of good quality, and the articles are liberally illustrated, many of the illustrations consisting of excellent colored plates. The publication can be heartily recommended to all students of neurology and psychiatry, and represents by all odds the most important recent addition to the bibliography of these subjects.

Those interested in the introduction of pathological work into asylums will do well to read the preface to the volume, written by Dr. W. J. Collins, who was formerly chairman of the London County Council. Dr. Collins, after speaking of the importance of the study of the pathological lesions in cases of insanity, describes the origin of the Claybury institution and refers briefly to the plan of the pathological laboratory established there. A significant feature is the endowment by the Technical Education Board of several research scholarships. The fact that such well-known names are connected with these scholarships proves the desirability of such endowments. Where a group of trained investigators can be gathered together under one roof, the output of a laboratory ought to be much greater than where the same individuals work independently in different places. The danger of accumulating, by the scholarship method, a group of *dilettanti* is not a serious one, provided the choice of men for the positions is relegated to the active pathologist in charge.

LEWELLYS F. BARKER.

**A Laboratory Manual of Physiological Chemistry.** By E. W. ROCKWOOD, B. S., M. D. (*Philadelphia: F. A. Davis Co., 1899.*)

Instructors in physiological chemistry have long felt the need of an English manual which will contain clear and accurate descriptions of well-selected experiments, noting the precautions that must be observed in order that the experiments may be brought to a successful conclusion, and giving at the same time a sufficient amount of descriptive material to make the object of each experiment intelligible.

This little book, which might more properly be termed an elementary manual, certainly fulfills these conditions. The material is printed in two kinds of type, so that it is optional with the instructor whether the course be made one of moderate duration or a somewhat shorter one. The student is introduced to chemical



processes which are more or less confined to physiological chemical work, by an introductory series of experiments on the three great classes of organic foods; then follow brief chapters on the various tissues and fluids of the animal body. Cuts of microscopic preparations, tables for the preparation of re-agents, and a rather poor spectroscopic chart are also given.

The manual however is not above serious criticism. The whole modern science of physical chemistry is simply ignored, and the author believes that urinary indican is formed somewhere in the body by the union of potassium and sulphuric acid with indoxyl. In spite of these and numerous other shortcomings which could be cited, we believe the book to be, on the whole, worthy of recommendation as an experimental guide.

**The Cranial and First Spinal Nerves of Menidia.** A Contribution upon the Nerve Components of the Bony Fishes. By C. JEDSON HERRICK, Associate in Comparative Neurology, Pathological Institute of the New York State Hospitals. pp. 1-299, with seven plates and several illustrations in the text. (*Utica: State Hospitals' Press, 1899.*)

If one looks over the contributions to neurology, which have been made by American investigators in recent years, he is struck by the fact that a large proportion of these refer to the comparative anatomy of the nervous system. This is doubtless due, in the first place, to the high standards which have been set in biological work in this country; and secondly, to the fact that, of the large number of investigators trained in biological laboratories, several of the best men have been attracted toward neurological problems. While it may be true, that many of the studies in comparative neurology have appeared to have but little bearing upon more distinctly medical problems, medical neurologists have, of late, come to appreciate the marked advantages derivable from a view of the human nervous system from the standpoint of comparative anatomy. The studies upon the phylogeny of the cerebral cortex, and upon the primary and secondary visual and auditory centres need only be mentioned in order to recall to mind the new light upon the structure and functions of the human nervous system, which is attributable to such studies.

The investigations of O. S. Strong, upon the cerebral nerves of the amphibia, inaugurated a new series of researches, the results of which promise to be of very high importance also for human neurology. The application of the doctrine of nerve components to the cerebral nerves followed naturally upon the "four-root theory" earlier formulated for the spinal nerves. Strong's researches on the tadpole established, for the first time in the same type, both the central and the peripheral relations of the sensory components of the cerebral nerves. Since his studies, a number of students have undertaken similar problems connected with other types. The extreme diversity in structure met with among the various groups of fishes makes them particularly suitable for the continuation of such researches, and a number of investigators are at present directing their attention in large part toward the study of the morphological variations met with in these animals.

The work before us represents a most elaborate contribution to our knowledge of this particular subject, dealing as it does with the nerve components in *Menidia*, the ordinary species called "silver-sides," so abundant in shallow water near Woods Holl, Massachusetts. Dr. Herrick, after an introductory section, discusses the lateral-line canals and their organs, the central relations of the cranial components, the spinal nerves, the nerves of the vagus group, the auditory nerve, the trigemino-facial complex, the sympathetic nervous system, the eye-muscle nerves, the optic nerve and the olfactory nerve and nasal organ. Space will not permit us to enter into a description of his findings or discussion of his results. It will suffice to call the attention of neurologists to this very valuable research. It must be read by

every worker who wishes to be familiar with the newer studies in the domain with which it deals. Dr. Herrick's section XII, devoted to certain general considerations, makes especially interesting reading. In his section XIII, he has epitomized his results, and if one has not the time to master the whole article, he can find in this chapter, succinctly recapitulated, the principal points of the paper. To the reviewer it seems a matter of very high interest, that the comparative anatomists have been able to isolate so perfectly the various components of the cerebral nerves. The solutions of many of the problems, as worked out in these lower forms, can scarcely fail to be of great help in the clearing up of certain very complex problems which now puzzle the human anatomist, especially in connection with the rhombencephalon.

L. F. B.

**Recollections of a Rebel Surgeon** (and other sketches), or, **In the Doctor's Happy Days.** By F. E. DANIEL, M. D. Illustrated. (*Austin, 1899.*)

This little book comes to us from the *Texas Medical Journal*, and contains a number of sketches which have appeared in that Journal during the past year. They are often humorous; sometimes pathetic; and at all times interesting. They are especially of value, as giving a picture of the state of things in the Southern Confederacy during the Civil War, and as such must always be read with interest. The humor is sometimes a little coarse; sometimes far-fetched, but the general effect of the book is pleasant, and one who has started to read it is likely to continue to the end.

**Proceedings of the New York Pathological Society, 1897-1898.**

Besides containing the pathological descriptions of a very large number of anatomical specimens brought before the society, this volume is also enriched by a long and valuable paper by W. T. Sedgwick, "On the Establishment and Conservation of Purity in Public Water Supplies." A great variety of subjects were presented for consideration to the society, and there are many interesting discussions on abnormal hearts, livers, lungs, kidneys, etc. There is an index to the volume, so that it is easy to look up any subject in which one may be interested; but the index should be better arranged—it is needlessly complex, with double references.

**The Modern Treatment of Wounds.** By JOHN C. SCHMERS, Jr., M. D. (*Omaha: Medical Publishing Company, 1899.*)

It is a pleasure to come across a small work of this kind, which can be highly praised and recommended. The treatment of surgeons varies like that of doctors, but this is a work which can safely be put into the hands of any young surgeon, and it will do many an older surgeon good to read this book. It is supplied with a good index, and with a few illustrations, some of which might have been better chosen, but it is the text which is essential, and this deserves commendation. There is one point on which we believe the author is somewhat too progressive in his surgery, and that is in the treatment of perforating wounds of the orbit, and skull as a whole. Somewhat more conservatism in the treatment of such wounds seems to us advisable. We note also that he says nothing of the value of prolonged baths in the treatment of severe wounds of large surfaces of the body, and it appears to us also that the strength of the solutions of bichloride of mercury, which he uses for burns, is too high. That the book, however, will be found most useful by many practitioners, we have no doubt.

**Love and its Affinities.** By GEORGE F. BUTLER, M. D. (*Chicago: G. P. Engelhardt & Co., 1899.*)

Under this somewhat illusive title, the author attempts to make clear in a short treatise the psychology and binding links of lust, love, and religion. The thesis shows a wide reading of both ancient

and modern authors, especially the poets; but while it will do no one any harm to read this little work, it is doubtful whether after having read it, he will find himself any the wiser. That this triune is intimately bound together, none will attempt to deny, but like so many other problems in psychology and philosophy, the explanation of this unity seems to lie outside the power of words to express. We understand their association, but no one can explain love, any more than he can explain any other pure mental or physical quality; for the mind and body, are so intimately connected, that it is almost impossible to separate one from the other. However, the author has treated his subject delicately, and deserves praise for this, for it is difficult to treat lust and love in the same category, for the ideal passion is much more intangible and inexpressible than the physical.

**Hints on Elementary Physiology.** By FLORENCE HAIG-BROWN. (Philadelphia: P. Blakiston, Son & Co., 1897.)

This is an excellent little primer for nurses; and the introduction, by Dr. William M. Ord, is a recognition of its merit. He says: "As an evidence of earnest diligence in preparation for what is one of the most responsible and certainly the very hardest possible occupation in life (nursing), it calls for all praise and respect. The qualities of the book will, I am well assured, command the success which I most heartily wish for it." It is abundantly illustrated, and the plates are for the most part good, but some should be changed in a second edition, especially that one illustrating the mucous surface of the ileum, on page 79. We do not desire to be hypercritical, but on page 101 the author states that the tongue "is composed of muscle, fat, the hyoid bone, and the lingual vessels and nerves." In such an elementary treatise as this, is it not a little misleading to consider the hyoid bone as a portion of the tongue? Under the title of ventilation, we find the temperatures, given as suitable for dwelling rooms, surgical and medical wards, etc., very low—much lower than is the custom here in America to keep such rooms, and we believe too low for health in many cases. This little book is, in spite of any small deficiencies, far superior to many larger works on this subject written for nurses, and it is to be hoped it may have a wide circulation.

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# BULLETIN

OF

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### NOTES ON AN IMPROVED METHOD OF REMOVING THE CANCEROUS UTERUS BY THE VAGINA.

By HOWARD A. KELLY, M. D., *Gynecologist-in-Chief, the Johns Hopkins Hospital.*

My ideas upon the subject of the extirpation of the cancerous uterus (cervical cancer) have undergone considerable change within the past year. A careful examination of my material and reports from other clinics have shown that we dare not reason too closely upon a supposed analogy between cancer of the uterus and cancer of the breast; in other words, glandular metastases, which play such an important part in the extension of mammary cancer are relatively unimportant, and as a rule, only observed in the latest stages of uterine cancer.

More careful histological studies show that the uterine cancer extends progressively through the tissues from its cervical focus. The great aim of the operation for the extirpation of cancer, becomes, therefore, that of giving the diseased cervix the widest possible berth, instead of being, as before supposed, the removal of the uterus plus the extirpation of the pelvic glands.

In the first place the frequent recurrence of the disease in the scar tissue of the vaginal vault points to the importance of commencing the enucleation on the vaginal side at a point far below the manifest limits of the invasion, not less than 2-2½ cm. distant or even more.

In order to give the diseased cervix the widest possible berth in the direction outwards into the bases of the broad ligaments, I would again insist upon the necessity of catheterizing the ureters in every case as a preliminary to the radical operation. This can be done by putting the patient in the knee-breast position, and introducing my open vesical speculum, and carrying one of my renal catheters up into one kidney and then catheterizing the other. The patient is then turned on her back and the air allowed to escape from the bladder through a vesical catheter, and the enucleation proceeded with.

If this preliminary catheterization is not done, the operator is forced to adopt one of two courses, both of which are bad; either he must skin out the cervix for fear of including the ureters in his ligatures, or he must consume a long time in a difficult dissection of the ureters not marked out by the bougie. The latter alternative many feeble patients will not stand. I insist, therefore, with the utmost earnestness and emphasis that the surgeon who proposes to give his patient the best possible chance of recovery is under the absolute necessity of learning to catheterize the ureters.

After this most important preliminary and after a thorough

curettage of the diseased area, I cut through the vagina on all sides and proceed to strip it loose from the bladder, so as to expose the vesico-uterine peritoneum, and to open the peritoneum as widely as possible at this point. If the bladder is diseased, the base of it may be cut off and left sticking to the cervix.

The peritoneum is now also opened posteriorly into the recto-uterine pouch so that the uterus remains attached by its broad ligaments alone.

A gauze pack is then put into the pelvis behind the uterus and the cervix is thrust back against it, while the anterior uterine wall is caught with museau forceps step by step and drawn down through the anterior incision until the fundus appears at the vaginal outlet.

The next step now is to bisect the uterus from above downward; this is not attended with any serious bleeding.

The surgeon now proceeds to remove the uterus in the following manner: one half of the body of the uterus is caught by a stout museau forceps, while the other half is allowed to retract within the vagina; then, catching the cervix of the same side with the forceps, the body is completely severed from the cervix by dividing from within outward. As soon as the division is completed, the uterine vessels are clamped in the exposed cellular tissue, and the detached body is now pulled further out and the round ligament clamped, and lastly the uterine cornu. In this way one quadrant of the uterus is removed. The body of the uterus on the opposite side is next removed in like manner.

Ligatures are then applied in place of the clamps. The ovaries and tubes are removed after the body of the uterus. It is, as a rule, much easier to remove the ovaries and tubes in this way when there is more room secured than to take them out with the body of the uterus. The removal of the body of the uterus in this way affords so much room that it now becomes an easy matter to take out the cervix on the side which is least implicated, under all circumstances giving it the widest possible berth, and keeping the rigid catheterized ureter under touch all the time during the enucleation.

The steps of the operation as thus far described, which have been rapidly and easily conducted, may be looked upon as more or less preliminary; three-quarters of the uterus have been removed and the remaining quadrant, that half of the cervix which is on the side where the infiltration of the broad ligament is most marked, now remains to be extirpated also, completing the operation.

In reality so important is this last step that the operation may at this point be looked upon as only having just begun. All the skill of the operator must be concentrated upon this step, upon securing the most thorough, wide extirpation of this remaining piece.

In order to do this as effectively as possible, the extirpation of the three portions indicated has afforded a maximum space, and the operator is not now embarrassed by the presence of the uterine body in the pelvis. He holds in the grasp of his forceps a small nodule, one-half of the cervix, and his desire is to get it out with perfect control of the vessels giving it the widest possible berth. This may be done in some cases by ligature, but will be better done in other cases by cantery clamps such as have been devised by Dr. Skene, of Brooklyn, or by igniextirpation as extensively practised by Mackenrodt of Berlin (see Martin's Festschrift, 1895, p. 100).

If the ureter lies clearly beyond the diseased area and is unaffected, it may be dissected out and left intact; in many of these cases, however, the operator must not hesitate a moment in cutting off the ureter above the diseased area, and proceeding with the wide enucleation of the nodule as if the ureter did not exist. After the enucleation is over, the ureter may then be readily turned into the denuded bladder and stitched there (uretero-cysto-neostomy).

The anterior and posterior peritoneal surfaces are then drawn down and attached to the vagina, and are again sutured together in the middle line, so as to leave but two small openings up into the pelvis which are loosely stuffed with gauze.

While the cases operated upon are still too recent to be offered in evidence, there can be no doubt whatever that this plan of operating, like any other plan which gives the disease a wider berth, must give a better percentage of permanent recoveries.

CASES: F. J., Nov. 7, 1899, Gyn. No. 7351.	
S. S., Nov. 14, 1899, " 7370.	
E. J., Nov. 14, 1899, " 7371.	
S. T., Nov. 18, 1899, " 7384.	
E. M., Nov. 29, 1899, " 7405.	
K. H., Nov. 30, 1899, " 7411.	
M. J., Dec. 21, 1899, " 7428.	
M. H., Jan. 10, 1900, " 7495.	
I. B., Feb. 24, 1900, " 7582.	

## A PRELIMINARY REPORT ON THE SURGICAL TREATMENT OF COMPLICATED FIBROID TUMORS OF THE WOMB, WITH A DESCRIPTION OF TWO METHODS OF OPERATING.

BY HOWARD A. KELLY, M. D., *Gynecologist-in-Chief, the Johns Hopkins Hospital.*

It is now four years and a half since I described before the Southern Gynecological Association, at a meeting in Washington, November 12, 1895, a new method of performing a supravaginal myomectomy for fibroid tumors of the uterus.\*

This new method of enucleation was by means of a continuous incision through first the ovarian, then the uterine vessels of one side, down under the tumor, cutting across the cervix, and catching the uterine vessels of the opposite side as they are exposed, and up the broad ligament to the round ligament, and last of all the corresponding ovarian vessels. By means of this rapid plan of enucleation the tumor and

\*See BULLETIN of the Johns Hopkins Hospital, Feb., 1896.

the part of the uterus involved with it are rolled out and all the vessels controlled within three or four minutes.

Complications on the part of the tubes and ovaries, in the form of adhesions, hydrosalpinx and pelvic abscesses, are also more easily dealt with under this plan of enucleation than under any other. It is always easier to attack an inflamed tube and an ovary from the front of the broad ligament which is opened up in this way, than to attack the same inflamed structure from the posterior part of the pelvis before enucleating the tumor.

The large experience which I have gained since publishing the paper above referred to has only served to confirm my conviction that no other plan of operating can rival this one in simplicity, in rapidity, and in affording complete control of the complications referred to.

While this plan is the best for the vast majority of cases, occasionally a complicated case turns up in which it can only be applied with difficulty. I have in mind several cases which have recently passed through my hands where neither the common method of performing hysteromyomectomy, that of tying down on both sides to and including the uterine vessels, and then amputating the cervix, nor my own method of the continuous transverse incision epitomized above was applicable without great difficulty and considerable risk to the patient.

The first case in which I found it necessary to make a radical departure in the method of enucleation belonged to the group of cervical myomata. In this instance there was no cervix to be felt by the vagina, and on opening the abdomen the bladder was found raised half way up the umbilicus by an ovoid tumor choking the pelvis, with its long axis vertical. The body of the uterus containing a few small nodules sat high up in the abdomen above the umbilicus like a cap on top of this tumor and on the right and on the left sides the displaced uterine and ovarian vessels were spread out in a network. I began the enucleation by trying to tie off these vessels wherever I could catch them on the left side. There was a great deal of hemorrhage from the surface of the tumor, and as soon as I commenced to detach the ligated vessels and to push them down the hemorrhage increased. It was evident that the patient, who was already feeble and anæmic, could not survive the operation if there was to be any additional considerable loss of blood. I then at once resorted to the following plan which promptly overcame the difficulty and speedily terminated the operation without further loss of blood:

I took two long-jawed pedicle forceps and controlled all the vessels on each side of the uterus on top of the tumor by thrusting one of the open jaws of the forceps through the capsule of the tumor on one side at about the level of the round ligament from the front of the broad ligament until the point appeared on the posterior surface of the tumor behind the broad ligament; I then clamped the forceps powerfully down on the uterine and ovarian vessels, entirely controlling the circulation. Both sides were treated in this way.

I then took a long-bladed knife, and grasping each uterine cornu with stout short-toothed museau forceps and pulling

in opposite directions, I bisected the uterus and cut on down into the tumor as far as the vesical peritoneum, which was freed and pushed down, when the tumor was completely bisected.

The next steps were the enucleation of the left and the right halves of the tumor. Grasping the left half of the tumor at a convenient point and pulling it away from its bed with a pair of museau forceps it was rapidly enucleated from its uterine bed by means of a blunt crenated spatula, which I always use in the enucleation of myomata. The right half was then enucleated in the same way. All these steps were carried out without a particle of hemorrhage, in remarkable contrast to the beginning of the operation.

With the enucleation of the large cervical tumor the tissues surrounding it collapsed, and the uterine artery was easily reached and tied at a selected point below the body of the uterus, and all the difficulties of the situation vanished and the case became a simple one. The two halves of the uterus were enucleated separately and the bed of the tumor closed by buried sutures and the vesical peritoneum drawn over and attached to the posterior peritoneum concealing the wound and the operation finished.

The enucleation of the bisected uterine body may be done after the removal of the tumor in one of two ways—either by tying the ovarian vessels, now easily reached, and the round ligaments and lastly the uterine vessels and then amputating, or by severing first one then the other half of the uterus from the cervix below, cutting from within outwards, from the centre of the cervix towards the broad ligament, and so exposing and catching the uterine vessels, after which they are divided and each half is pulled up in turn by its cervical extremity and the round ligaments of the ovarian vessels tied in order. The direction of the enucleation in this case is from below up, the reverse of the direction ordinarily taken; the extirpation in this way is facilitated by the sagittal bisection of the uterus.

The patient made an excellent, uninterrupted recovery, and has returned to her home and duties in the country.

I would urge this plan of dealing with fibroid tumors of large size occupying the lower uterine segment, and elevating the uterine as well as the ovarian vessels, and choking the pelvis; in these cases the vessels cannot be tied in mass, but require numerous separate ligatures, and the operator is constantly embarrassed by hemorrhage if the ordinary plan is pursued.

The other case in which still a different plan of operating was found necessary was that of a fibroid tumor filling the pelvis and reaching as high as the umbilicus. The patient, when put on the table, had a rapid small pulse which speedily ran up to 140.

I opened the abdomen, and after releasing some omental adhesions, found the large tumor firmly fixed in front of the vertebral column behind the umbilicus by extensive dense adhesions. The colon was so intimately attached to it that it soon became evident as I tried to detach it that a continued dissection would necessitate an extensive resection of the bowel. I then resorted to a plan successfully adopted in a previous case, January 24, 1891 (See Gyn. Reports, No. 2, p.



582), that of leaving a thin layer of the tumor upon the bowel, that is, of sacrificing the tumor for the sake of the bowel. As soon, however, as I cut into the tumor it began to bleed freely, and I did not dare to go ahead on account of the condition of the patient.

I then turned to the lower pelvic pole of the tumor, hoping to be able to free it by tying off the vessels from above downwards and amputating the cervix; I found it attached to the whole anterior surface of the uterus above the cervix, pushing the fundus of the uterus down to the pelvic floor out of reach. I was able to place two clamps on the tops of the broad ligaments controlling the ovarian vessels, but this was not a necessary step in the following procedure then adopted, which met the complications in a satisfactory manner.

The cervix which could be felt at the vesical reflection was caught by stout short-toothed museum forceps and pulled up within reach; the vesical peritoneum was detached and pulled down, exposing more of the cervix, which was caught with a second pair of forceps.

A knife was then plunged through the cervix in an antero-posterior direction between the two pairs of forceps, and the cervix was cautiously divided from side to side (that is to say coronally or transversely) by pulling the divided cervix apart. The cellular tissue to the left of the cervix was first exposed, and the uterine vessels, not yet seen, clamped with a short, stout forceps; the uterine vessels on the right side were next controlled in the same way.

When these important vascular trunks were thus secured, the upper forceps was forcibly used to drag up the tumor and uterine body, rotating them on a transverse axis, exposing first the round ligaments and then the ovarian vessels of the left and the right sides, respectively; these structures were clamped and the whole mass disconnected from its pelvic attachments. The tumor now only remained adherent by the dense adhesions at its upper pole. The next step was the rupture of an enormous abscess lying behind it and extending from the centre of the tumor into a sac bordered posteriorly

by the lumbar vertebræ and above by the mesocolon and discharging through a large opening into the transverse colon. The tumor now rolled out, being enucleated from behind forward without added injury of the bowel, other than was rendered necessary by the opening into its lumen. The contaminated abdominal cavity and the abscess cavity, containing at least a litre of thick yellow pus, were cleansed, the opening in the bowel sutured and the long abdominal wound closed, leaving a large iodoform gauze drain about the umbilicus into the remainder of the sac under the colon.

The patient has made an excellent recovery with a small rapidly closing fistulous tract.

This type of operation is, I think, the very best that can be adopted for those cases in which there are dense adhesions to the upper pole of the tumor which cannot be dealt with without great risk by attacking them in a direction from before backwards.

I have tried the first plan of operating by bisecting the fibroid uterus in eight cases in all; it has so happened that several complicated cases of tumor developed in the cervical region have recently come into my hands. In the other cases I simply made the enucleation in this fashion in order to demonstrate its feasibility. The continuous transverse incision must always remain the operation of elective choice.

The second plan of operation has been followed in but one case (K. H.).

CASES: A. W., December 10, 1899, No. 7438.

C. W., December 21, 1899, No. 7460.

T. B., January 1, 1900, No. 7474.

A. S., January 3, 1900. (Sanatorium.)

M. B., January 27, 1900, No. 7537.

D. C., February 4, 1900, No. 7552.

E. H., February 24, 1900, No. 7583.

M. K., February 26, 1900, No. 7597.

K. H., February 1, 1900, No. 7549. (Myoma with abscess opening into colon.)

## OBSERVATIONS UPON THE NEURAL ANATOMY OF THE INGUINAL REGION RELATIVE TO THE PERFORMANCE OF HERNIOTOMY UNDER LOCAL ANÆSTHESIA.\*

By HARVEY CUSHING, M. D., *Associate in Surgery, the Johns Hopkins University.*

### INTRODUCTION.

During the past two years in a considerable percentage of the large number of herniotomies performed in Dr. Halsted's clinic recourse has been made to methods of local anæsthesia. In thirty of these cases definite contraindications to the employment of general narcosis have been present, and from this number two definite groups may be recognized:

(I) Those cases in which immediate operative intervention is demanded, as in strangulation, and in which ether is contraindicated from the shock and vomiting associated with ileus;

And (II) the cases in individuals advanced in years who desire to become rid of an annoying hernia, and who a few

years ago were uniformly refused operation, since associated cardiovascular lesions, chronic bronchitis and emphysema with other senile changes made them submit to the administration of general anæsthesia with notorious uncertainty.

When there exists no apparent contraindication to the administration of ether or chloroform, however, it may safely be said that the anæsthesia of the operator's choice will continue to be a general and not a local one. Nevertheless, during the past few months observations upon the nervous anatomy of the inguinal region to be reviewed in this paper, have so greatly assisted us in the development of a painless operation that this statement may be qualified to a considerable degree. Since August of 1899 thirty-two herniotomies with cocaine or eucaine  $\beta$  have been performed upon young

\* Extracted from *The Annals of Surgery*, Vol. XXXI, 1900, p. 1.

men who might without risk have taken a general anæsthetic, and in many instances absolutely without the infliction of pain other than that incidental to the first insertion of the needle. During the fall this procedure became so popularized in the ward where our hernia cases were admitted that the operation under the local anæsthetic became the method of the patient's choice. An individual awaiting operation needed to remain in the ward only long enough to compare the convalescence of an ether case with that of one done under cocaine to choose the latter for himself. Such patients usually regard the shaving and skin preparation as the most trying part of their operative ordeal, and most of the original observations on cutaneous anæsthesia were made on these cases during the operation and immediately after closing the wound. It has been found also that the patient can assist not a little in certain steps of the operation, as, for example, when the neck of the sac is closed, in making negative abdominal pressure to prevent the omentum, or bowel, from being pushed down between the peritoneal sutures.

#### OBSERVATIONS FROM COCAINE OPERATIONS UPON THE NEURAL ANATOMY OF THE HERNIAL REGION.

The application of an anatomical familiarity with the peripheral distribution of the spinal nerves, which since the introduction of ether and chloroform has fallen into abeyance, has become once more of interest and importance to the surgeon in extensive operations under local anæsthesia. Furthermore, no condition has ever afforded similar opportunities for the accurate investigation of the sensory distribution of these nerves, since methods of dissection are necessarily gross, and physiological experiments upon animals naturally present variations from the human type.

The principles of cocainization of main trunks of nerves, introduced as early as 1885, have since been utilized in operations on the extremities for minor and even major amputations,\* for the anæsthetization of areas on the thigh preliminary to the removal of Thiersch grafts and like procedures, but I am unaware that heretofore similar methods have been made use of in operations on the trunk. To insure success in any major operation attempted under local anæsthesia, an accurate knowledge of the course and situation of the nerves likely to be encountered is most essential, since the accidental division of an unexpected sensory nerve-trunk is often sufficient to overcome whatever preliminary inhibition to pain the patient may have had, and thus to make recourse to complete narcosis necessary in cases where it should, perhaps, be specially avoided. In our earlier hernia operations pain was not infrequently inflicted where now none is occasioned, owing to greater familiarity with the course and distribution of the nerves concerned.

\* Absolutely painless amputations of the lower extremity for senile gangrene in individuals to whom it seemed unwise to administer ether have on two recent occasions been performed at this hospital after preliminary exposure and cocainization of the sciatic nerve in the thigh (under cocaine). This procedure is free from the objections which seem to attend Bier's method (*Deutsche Zeitschrift für Chirurgie*, 1899) of cocainization of the spinal cord.

In the accompanying sketch (Fig. 1) an attempt has been made to show diagrammatically the usual cutaneous distribution of the inguino-scrotal nerves as well as the deeper situation of the main trunks. Through the kindness of Dr. Bardeen I have been able to compare with my results a great number of sketches made in the anatomical department for an unpublished report on the peripheral nervous system, and though there is considerable variation in the situation and anastomoses of the particular nerves of this region, as may be seen by consulting Griffin's article (*Journal of Anatomy and Physiology*, 1891), we have taken what may represent the average.

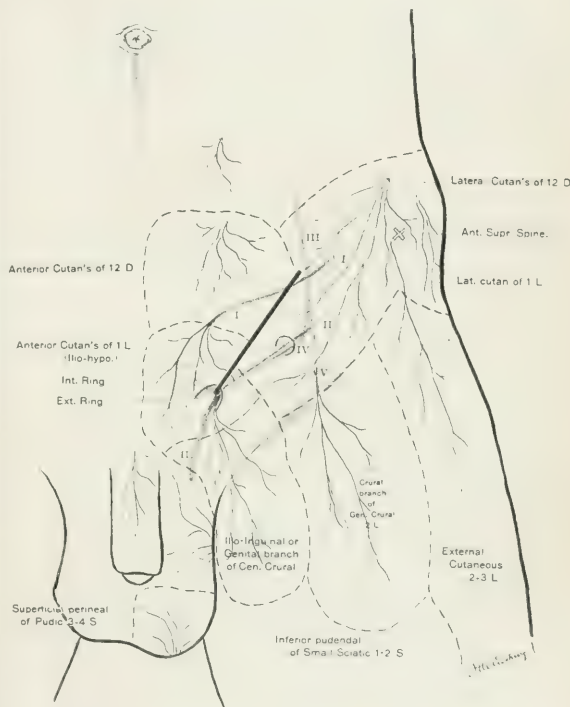


FIG. 1. Showing inguino-scrotal nerves, their peripheral distribution and relation of the main trunks to the hernia incision. I, Ilio-hypogastric; II, Ilio-inguinal; III, Genito-crural; IV, Genital branch; V, Crural branch.

*Superficial Nerves encountered by the Incision.*—The skin incision, as ordinarily made, passes in a line which separates the ventral and lateral cutaneous branches of the twelfth dorsal and first lumbar nerves. The lower angle of the incision, however, quite uniformly overlaps the anterior branches of the first lumbar ilio-hypogastric nerve, as they sweep downward and outward from their point of emergence through the aponeurosis, about five centimetres above the external ring. The upper angle of the incision, depending

somewhat on its distance from the median line, and also upon the variable and complementary length of filaments of the

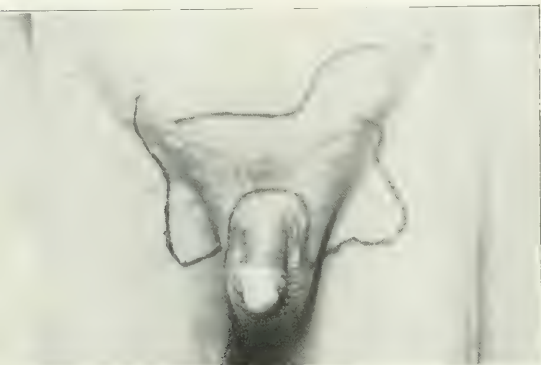


FIG. 2.—Areas of anesthesia after double cocaine herniotomy. Anesthesia lies to the inner side of left incision, which was made nearer Poupart's ligament and has divided lateral cutaneous branches of twelfth dorsal. It lies to the outer side of the right incision made farther from Poupart's and dividing fibres from the anterior division of twelfth dorsal. This was one of our earlier cases in which no attempt was made to preserve the nerves, and the anesthesia is permanent.

ventral and lateral branches of the twelfth thoracic, may divide fibres from one or the other of these sources, and thus lead to a subsequent area of anesthesia to the inner or outer side of this upper angle of the incision. This is well illustrated by the accompanying photograph (Fig. 2) of a double



FIG. 3.—Showing small post-operative area of anesthesia to the inner side of the incision, consequent to the division of lateral cutaneous branches of the twelfth dorsal. In this case the ilio-inguinal and genital branch of the genito-crural had been divided with loss of cremasteric reflex, but without producing any cutaneous anesthesia.

herniotomy, in which the incisions were made at different distances from the median line. This bordering anesthesia, on one side or other of the skin incision, may occasionally represent the entire area of post-operative cutaneous anes-

thesia, even when the ilio-inguinal and the genital branch of the genito-crural have been divided or cocainized, as is shown in photograph (Fig. 3). Presumably in such instances the crural branch of the genito-crural supplies the area on the inner side of the thigh (cf. Fig. 4) usually innervated by the former two nerves. Such an arrangement occurs not infrequently in Dr. Bardeen's diagrams. On several occasions there has been no resulting post-operative area of cutaneous anesthesia whatever.

*Deeper Nerves met in the Operation.*—The ilio-inguinal nerve emerges from the external ring, and near by, or also through the ring, the genital branch of the genito-crural appears. In the canal they frequently are found anastomosed as one trunk, the early cocainization of which at the deeper part of the canal, after splitting the aponeurosis beyond the internal ring, is perhaps the most important step of the operation. As has been stated above, this may result in no additional *cutaneous* anesthesia. The usual anesthetic sequel, however, is represented by a complete loss of sensation of the entire scrotal contents, cord, hernial sac, and testicle, with the possible exception of its lower vascular supply (superficial perineal),



FIG. 4. Area of anesthesia of ilio-hypogastric, ilio-inguinal, and genital branch of genito-crural in a unilateral cocaine case, following operation. This began to fade by the twenty first day, with return of cremasteric reflex. This represents the most complete type of anesthesia in unilateral cases, and is the same even after division of the cord and castration, and consequent section of all possible cutaneous filaments of the genital branch of the genito-crural and the ilio-inguinal.

and by a cutaneous area of anesthesia which occupies the inner side of Scarpa's triangle, spreading over the adductor tendons. Division of the nerve is unassociated with any surface anesthesia of the scrotum whatever (cf. Fig. 4). It is ordinarily stated, to the contrary, that these nerves are a source of cutaneous supply to the scrotum; for instance, Professor Thane says (Quain's "Anatomy," Vol. iii, Pt. II, p. 341, 1895), "The root of the penis, on its dorsal aspect, and a part of the scrotum anteriorly are supplied by the ilio-inguinal and genito-crural nerves." It was of extreme interest, consequently, to find that the ilio-inguinal, supplying most of the *contents* of the scrotum, was not represented by any *cutaneous* distribution to the same. The inferior pudendal branch of the



small sciatic and superficial perineal of the internal pudic, therefore, supply in most cases, at all events, its entire cutaneous surface. It is possible that, on the principle of Sherrington's observation concerning the overlapping of sensory areas, we might account for the failure of anaesthesia after division of the single nerve to appear over the whole territory innervated by it, but as will be seen by comparing segmental spinal lesions such an explanation will not hold, and probably the whole scrotal cutaneous supply is from the sacral and not the lumbar plexus. A case of fracture-dislocation of the spine at

internal pudic (second and third sacral) nerves. If the ilio-inguinal normally overlapped the latter nerves, the root of the penis and upper part of the scrotum would naturally have retained sensation. A similar condition is shown in one of Kocher's diagrams of a case of fracture-dislocation at this level. (*Die Läsionen des Rückenmarks u. s. v.*, S. 627 t. In another of his cases (*Ibid.*, S. 631), in which the segmental lesion is at the 3-4 sacral level, the upper portion of the scrotum has retained sensation as the inferior pudendal (1-2 sacral) has escaped injury.

Furthermore, in this spinal case, as would be expected, the cremasteric reflex was retained, whereas we have observed that after division or cocainization of the ilio-inguinal and genito-crural nerves, this reflex is, temporarily, at all events, lost on the side of division.\* On the other hand, the vermicular movements of the dartos, supplied together with the skin by the sacral nerves, are preserved after divisions of the ilio-inguinal, but were lost in the spinal case together with the cutaneous anaesthesia.

The ilio-hypogastric, as will be seen in the diagram (Fig. 1), may be twice encountered in the operation; its superficial filaments by the skin incision, as has been described, and its deeper trunk, as it lies upon the muscle-fibres of the internal oblique at a varying distance from the lower edge of the muscle (Fig. 6). Cocainization of the edge of this muscle, consequently, before its division as in the Halsted operation, is very necessary, especially since, in addition to this main trunk, which may usually be easily recognized after exposure of the internal oblique, there are, contrary to Griffin's observations, off shoots to the muscle itself from this nerve, given off dorsad to the portion exposed by the incision. There are fibres from the genito-crural (Thane) as well, which are similarly distributed to this lower border of the internal oblique. The area of cutaneous anaesthesia, which follows anaesthetization or division of this main stem of the ilio-hypogastric at its point of exposure, surrounds the lower angle of the incision, and extends from a level about seven centimetres above the root of the penis to within one or two centimetres of that organ. No anaesthetic area has ever been found corresponding to Macalister's described branches reaching up towards the umbilicus. In unilateral cases this ilio-hypogastric anaesthesia does not extend to the median line, owing to the overlapping of fibres from the opposite side, so that in bilateral cases alone, such as are illustrated by Fig. 2, can its limits be definitely made out.

#### THE ANÆSTHETIC, AND APPLICATION OF ANATOMICAL OBSERVATIONS TO THE OPERATION.

It is not within the scope of this paper to discuss the relative merits of various local anaesthetics; suffice it to say that we have found the combination advocated by Schleich ("Schmerzlose Operationen," 1899) to be as efficacious as any with which we have experimented. His solution No. 2, containing the following ingredients:

\* It is important, therefore, to guard against division of these nerves in varicocele operations in which it is desirable to preserve cremasteric tone.

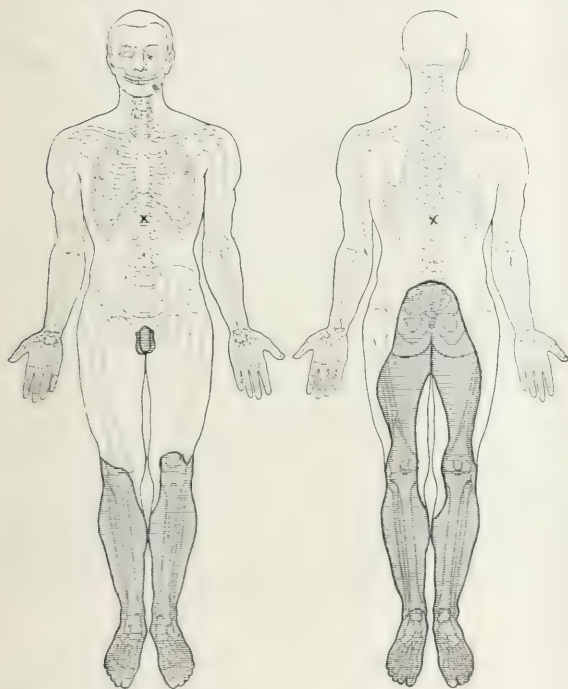


FIG. 5. Areas of cutaneous anaesthesia result from a compression fracture of the twelfth dorsal vertebra, producing a total transverse lesion at the fifth lumbar segment. Scrotal and penile anaesthesia are complete, though the lesion lies below the first lumbar ilio-inguinal segmental level.

the twelfth dorsal vertebra, with transverse lesion of the cord, entered the hospital at the time these observations were being made, and offered confirmatory evidence of what has just been stated. The anaesthetic areas resulting from this injury, and which are shown in the accompanying diagrams plotted by Dr. Yates (Fig. 5), offered an interesting negative of the anaesthesia following the hernia cases. Though the entire penis and scrotum in this case were devoid of sensation, the transverse lesion of the cord was situated at the fifth lumbar segment,—that is, between the level of origin of the ilio-inguinal (first lumbar) and that of the small sciatic and

Cocaine mur.....	0.1
Morphine mur.....	0.02
Sodii chlor.....	0.2
Aqua destillata, ad	100.00

has best served our purpose, and has been without the objections usually accredited to cocaine solutions,—viz., toxicity and dissolution when sterilized. Solutions in strength of 1 to 20,000, Schleich claims to be efficient for infiltration, and capable of producing anæsthesia which is free from the prodromal hyperæsthesia, the “anæsthesia dolorosa,” which accompanies aqueous and saline infiltrations. Amounts of the 1 to 1000 solution, however, greatly in excess of what is needed for the longest operation, have failed to give toxic symptoms, and, contrary to the experience of many, we have found that one or two sterilizations fail to diminish its efficiency. Experience with eucaïne  $\beta$ , which Braun (*Archiv für klinische Chirurgie*, 1898) and Hentze (*Archiv für pathologische Anatomie und Physiologie*, 1898) have so strongly advocated, has failed to demonstrate in our hands that it possesses any superiority over the 0.1 per cent cocaine solution of Schleich. In fact, we have been impressed by the fleeting nature of the anæsthesia and by its tardy appearance.

On several occasions long skin incisions have been made through a linear area of anæsthesia, produced half with sterilized Schleich's solution and half with the eucaïne  $\beta$  combination, which Braun advocates. If the operation is prolonged over an hour, pain is occasioned on placing the subcuticular suture of closure in the eucaïne area, while none appears in that which had been infiltrated with cocaine. The fact that its toxicity is five times greater than that of eucaïne does not argue in its disfavor, provided one uses solutions weak enough to avoid toxic effects. For anæsthetization of the individual nerve-trunks I have used a  $\frac{1}{2}$  to 1 per cent sterilized solution usually of cocaine which is injected directly into the nerve sheath.

*Steps of the Operation.*—Individuals—and it is especially important for those advanced in years—are usually kept in bed for a day or two preliminary to the operation, to give an indication of their ability to endure recumbency and for the purpose of training them to void their urine in this position. Evacuation of the bladder is usually accomplished by the aid of an enema if any postural difficulty is experienced, and it is a matter of satisfaction that but one of the cases reported in which these precautions were taken required post-operative catheterization, an old man, sixty-eight years of age, who had symptoms of prostatic hypertrophy.

It has been the custom to administer hypodermically a tenth or an eighth of a grain of morphine, three-quarters of an hour before, and to repeat this shortly before the operation. Ceci has emphasized the efficiency of this morphia-cocaine combination, and I have found it most satisfactory. The drug must be used with caution, however, since occasionally even small doses of morphine in old people may confine the bowels and lead to distention, which may be troublesome, as one of our cases illustrated. Similarly, in old people with tardy bladders, it may inhibit the proper evacuation of the urine, though we have never had the misfortune to observe this.

Patients past middle age also are usually shaved and cleaned

on the operating-table, to avoid any exposure incidental to an open-ward preparation. The skin in the line of proposed incision is infiltrated with Schleich's cocaine solution, and the incision may be immediately made through the linear wheal thus produced. It is common experience to find the infiltrated tissues more vascular than usual, and it is important that all bleeding points be immediately clamped, since a dry and unstained field is essential to the success of the dissection.\*

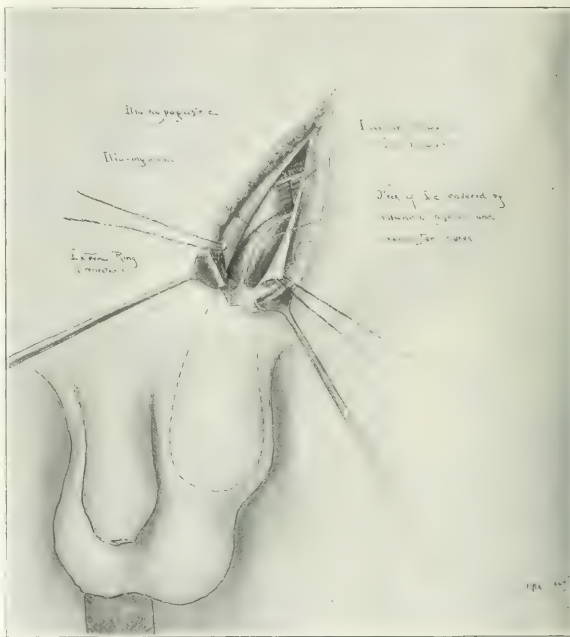


FIG. 6.—Sketch showing usual situation of nerves as exposed after reflection of the divided aponeurosis.

It is unnecessary and useless to attempt to anæsthetize the panniculus. As Schleich has shown, only tissues which can be “œdematized” are fitted for the infiltration method, and in the panniculus, at the upper angle of incision practically no nerves are encountered. If, however, throughout its whole length, this incision is carried down to the aponeurosis, unanæsthetized fibres of the ilio-hypogastric will be encountered in the superficial fat at the lower angle, together with one or two large veins, division of which is painful, so that anæsthetization of the panniculus layer would here be necessary. A much better method is to carry the incision only at

\*A good index of one's skill and familiarity with the hernia operation can be drawn from the condition of the tissues at the time of closure, for they should be as free from blood-staining as when first incised. This, of course, is the most important factor in obtaining perfect healing, and for the accomplishment of this a good assistant is indispensable. A perfect hernia operation is not a “one-man” operation.

the upper angle down to the aponeurosis, which is then opened in line of fibres from the external ring, and the ilio-hypogastric and inguinal nerves immediately cocainized with a 1 per cent solution as they are thus exposed. After this procedure the lower angle of the incision may be painlessly carried down to the external ring, and the remaining intercolumnar fibres of the aponeurotic insertion divided. Reflection of the pillars of the ring then gives the view shown in the accompanying sketch (Fig. 6). In the Halsted operation at this stage the internal oblique fibres are divided, preliminary cocainization of the edge of muscle being necessary for the reasons given above. There is, under ordinary circumstances, no further need of the anæsthetic, as we are working in an area freed from all sensation. The combined ilio-inguinal and genital branch, which has been cocainized at the outer limit of exposure, is now reflected usually to the outer side, care being taken not to divide it, since this leads apparently to a more or less permanent paralysis of the cremaster, which is to be avoided. I believe the accidental division of this nerve leads to the great relaxation of the scrotum so often seen after hernia and varicocele operations. In the latter operation, especially, it would be detrimental to the best interests of a successful result to interfere with the cremasteric function in any way. I think it not impossible also that the division of these nerves and interference with the sympathetic plexus about the cord may be responsible for the occasional atrophy of the testicle which has followed the great denudation of the vas deferens in some operations. The remainder of the operation, the exposure of the sac and cord after a longitudinal division of the infundibuliform fascia, the amputation of the sac at its neck, and closure of the peritoneal opening, the excision of the fundus of the sac, division of the cord and castration—if deemed advisable in senile cases—may now be done practically without pain. Occasionally, however, some stray fibres of the genito-crural may be encountered about the neck of the sac, and also during castration I have found that ligation of the veins at the lower pole of the testicle may be painful, though division of the cord above is not. Possibly the superficial perineal branches which have been unanæsthetized furnish nerves to this lower blood-supply.

The closure of the parietes by any of the more commonly employed methods may now be painlessly accomplished. Not infrequently in these cases, in old people with large hernias of long standing, the two rings have become concentric, and the falciform expansion of the conjoined tendon is no longer present. It is in such cases that Bloodgood has advocated transplantation of the rectus fibres after opening of the sheath and exposure of this muscle, so that a muscle-lined wound may be formed throughout the whole length of the inguinal canal. No additional cocainization is necessary for this step, since innervation of this portion of the rectus comes by the nerves already cocainized. Tightening the deep sutures in closing the wound may elicit a dull sensation of pain, which the patient usually describes as an uncomfortable sensation of "pressure" and it is occasionally possible that the upper one of the deep sutures must be placed above the field which is completely anæsthetized and thus be painful. For this reason it should be left to the last. The subcuticular

silver suture, used in closing the skin, does not pass beyond the limits of the original area of cutaneous infiltration, and consequently it may be placed without pain. Interrupted "through and through" cutaneous sutures, of course, must be avoided, as they would emerge outside of the limits of original cutaneous infiltration.

It occasionally happens during the operation, whether from slight ability on the patient's part to endure discomfort or from the accidental division of some sensory fibres, that what inhibition towards pain he may have at first possessed becomes exhausted, and recourse must be had to a general anæsthetic. Under these circumstances we have found that a few inhalations of chloroform—not enough, however, to make the patient lose consciousness—are sufficient to tide him over the most difficult parts of the operation. It is remarkable, under such circumstances, how small an amount of the general anæsthetic is requisite to benumb sensation. We may justly speak, therefore, of the method of anæsthesia which is employed as a *morphia-cocaine-chloroform* combination, the first and last drugs being merely adjuvants of the local anæsthetic, which in most cases suffices alone.

An assistant in these cases, who takes the place of the anæsthetist, occupies by no means an unimportant position. The usual record of pulse and respiration is kept, and by occupying his attention and by timely encouragement the patient may be tided over the more trying periods of his operative ordeal; duties which otherwise devolving upon the operator may be distracting. Lillenthal (*Annals of Surgery*, 1898, p. 58) speaks of this position as that of a "moral anæsthetist."

Patients have never complained of post-cocainization pain in the region of the incision, and healing seems to have been absolutely unaffected by the local infiltration. In none of these cases has there been other than primary union. It is very unusual for the large, starched, or plaster dressings, immobilizing thigh and pelvis, to be cut down before the tenth or twelfth day, when the suture is removed.

*Advantages of the Local Anæsthetic.*—There is an avoidance of unpleasant or dangerous post-etherization sequelæ. There is no vomiting or retching to put strain upon the recent sutures. Urinary disturbances are much less apt to occur, and catheterization is rarely necessary. The diet may practically be continued as before the operation. There is no backache, since there is no narcosis to induce relaxation of spinal muscles, and thus put strain upon the ligaments. The dressings may be applied originally to suit the comfort of the patient—which is of especial importance in old people—and there is no subsequent disarrangement of them. Above all is the advantage gained in being able to operate with comparative safety in patients who would incur immediate risk in submitting to general anæsthesia.

*Disadvantages.*—These seem trivial in comparison. More time is consumed in the operation, and there is necessarily some distraction to the surgeon. In two exceptional instances there has been some post-operative nausea for a few hours—possibly from an idiosyncrasy toward cocaine. The operation is doubtless more difficult and some pain is inflicted. The degree of this depends entirely, however, upon the surgeon's familiarity



with the use of local anæsthetics in abdominal work, as well as with the steps of the hernia operation and also upon his knowledge of the anatomical distribution of the sensory nerves of the region concerned. On many occasions no actual pain whatever need be experienced, and should there be some, it is small in comparison with the discomforts of an ether convalescence;

and the greater difficulties which confront the surgeon at the operating-table are more than compensated for by his subsequent freedom from the anxiety which, in this particular class of cases, attends the administration of, and convalescence from, general anæsthesia.

## THE PATHOLOGICAL FINDINGS IN A CASE OF GENERAL CUTANEOUS AND SENSORY ANÆSTHESIA WITHOUT PSYCHICAL IMPLICATION.

### ABSTRACT PAPER.

By HENRY J. BERKLEY, M. D., *Clinical Professor of Psychiatry.*

The detailed clinical history of this case can be found in *Brain*, Vol. XIV, Part IV, 1891. A careful search of the medical literature has disclosed no similar instance occurring either before or since the date of its publication.

A synopsis of the clinical record as then published shows:

- (1) A strong hereditary tendency to nervous instability; the mother, two maternal uncles, two brothers and two sisters having been insane. The father had died of tuberculosis.
- (2) A syphilitic infection acquired from her husband at the age of twenty-nine years, subsequent to which the patient had several abortions, sore throat and falling out of the hair.

For twenty-two years after the subsidence of acute symptoms due to the syphilitic process there was fair health. Then came an attack of acute arthritis, after which the patient never fully recovered her former physical condition. Within a few months thereafter, her eyesight began to grow dim, there were sudden flashes of light before the eyes, and vision was gradually extinguished, only sufficient remaining to enable her to distinguish light from darkness.

In the early summer of 1889, nearly six years after the rheumatic attack, the patient began to experience a general tingling and formication in the skin of the entire body, which was shortly followed by several spells of uncontrollable vomiting.

A consensus of the numerous examinations made during the years 1889 and 1890 showed a total loss of thermic, pain, olfactory, gustatory, equilibrium, pressure and weight sensations; almost total of the visual sense; and a partial loss of tactile and muscular impressions, muscular sense and auditory perceptions. None of the special senses, or cutaneous sensations remained wholly uninvolved.

Besides these disturbances of the sensory apparatus several other symptoms of almost equal prominence were recorded.

The musculature while responding to the will did so in such a feeble manner that the patient was incapacitated from helping herself to any extent. Thus the dynamometer when taken in the hand and squeezed was so feebly compressed that the indicator showed no movement on the dial, though the woman exerted every effort in the trial. Despite this fact, however, both nerves and muscles responded promptly to the galvanic and faradic currents, nor was there anything abnormal noticeable about the quality or time of the reaction.

The cutaneous reflexes were all abolished. The faucial and pharyngeal reflex movements were absent, and a sound could be passed over the epiglottis into the larynx without eliciting a sensation of discomfort or inducing cough. During the attacks of emesis there was no sensation of nausea.

When first examined the knee jerks were present and normal. The biceps jerk could also be elicited with some little trouble. The reaction of the abdominal muscles was lost, and the ankle beat was feeble. By the middle of July, 1890, the right knee reflex had disappeared, and the left one was weak. All other reflexes, deep and cutaneous, had been completely abolished. A year later the jerk of the left patella tendon was found to be extinguished.

Furthermore, with auditory perceptions a progressive dulling could be noted. When the woman was first admitted to the hospital, the sense of hearing was fairly acute in both ears. Gradually the difficulty in receiving auditory impressions increased, until finally the voice could not be heard except with strenuous effort.

The ophthalmoscopic examination showed an extensive choroiditis pigmentosa with atrophy of the optic nerves. Only a few vessels could be seen in the retina, and these were of minute size. In both lenses there was a beginning cataract.

Whether the optic nerve atrophy should be considered part of the general disease-process, beginning as it did long before the other symptoms, is somewhat problematical, though in tabes the same trouble is not infrequently noted as a forerunner of definite symptoms of the disease.

The pupils were at first in a state of mid-dilatation, and responded slowly to light, direct or reflected. They did not dilate on irritation of the cervical sympathetic. At a later stage the pupils became somewhat narrower, but remained sluggish to stimuli.

There were a number of interesting disturbances of the glandular secretions. During the fall of 1889 the mouth was found to be almost absolutely dry, the tongue heavily cracked, the epithelium eroded from its tip and sides, while the entire buccal surface was red and congested. At the same time the secretions of the lachrymal glands had almost ceased, the surfaces of the conjunctivæ being dry and injected. The skin was also dry and devoid of odor. After a course of potassium iodide these phenomena slowly abated, and the secretions returned to a more normal state.

Various unusual sensations troubled the patient at times. Cramps of the gastrocnemii, sensations of burning between the scapulae, a girdle feeling around the abdomen and neuralgic twinges in the nerves of the extremities were often complained of. Occasionally there were clonic fibrillary spasms of the small muscles of the thumbs.

Attacks of diarrhoea, refractory to treatment with drugs, though yielding to a continued milk diet, occurred in the latter part of the winter of 1890. These were on several occasions followed by a protracted vomiting without pain or nausea.

Trophic symptoms in the form of a bulbous appearance of the finger tips and ridging of the nails, together with purpuric spots, developed late in 1891.

Throughout the long course of the illness there was never the slightest departure from normal mentality on the part of the patient; no hysterical attacks, no pathological depression or exaltation, and no delusions or hallucinations were ever noted. A slight apathy was the only perceptible change in the mental phenomena, but this was not greater than is frequently noticed in those who have become blind and helpless.

In discussing the etiology of the sensory phenomena in the previous article, three possibilities were suggested: (1) that the malady was functional, an opinion largely influenced by the pathological findings in the three autopsies on cases of general cutaneous and sensory anaesthesia, reported by Von Ziemssen, Krukenberg and Schüppel respectively. This view was held to be hardly consistent with the presence of an optic neuritis, loss of the reflexes and the trophic manifestations; (2) that the case was an obscure instance of syringomyelia; or (3) that the terminal end-apparatus of the peripheral nerve fibres was diseased.

Though many points are not cleared up by the autopsy, and subsequent microscopic examination of the tissues, the results obtained are sufficient to show that none of these explanations would hold good, the nearest approach to a correct diagnosis being found in the last conjecture—disturbance of the peripheral nervous system.

The patient's condition did not materially alter after the record of the case was published. The anaesthetic and other symptoms, from the reports of the House Physicians to the Hospital, remained about stationary, and on the rare occasions on which I saw her, there were no additional phenomena to be noted other than a steady though slow decline of the vital powers. Late in the year 1893, another ophthalmoscopic examination was made by Dr. H. Friedenwald, who found in the left eye an extensive and typical retinitis pigmentosa, the papilla being blurred and of a dirty yellow color. Few vessels could be seen. In the right eye the clouding of the lens was so profound that the retina could not be seen.

About the middle of May, 1898, Mrs. R. became slightly lethargic, a condition that slowly increased to coma, in which state she died on the 25th of the month.

The autopsy, performed ten hours after death, was distinctly negative, all portions of the central and peripheral nervous systems showing an apparently natural condition. The larger vessels of the thorax, abdominal and cranial cavities,

showed scattered atheromatous plaques, but were not considerably thickened. The right middle cerebellar and both posterior communicating arteries of the circle of Willis were congenitally rudimentary. There was some gelatinous thickening of the pia over the central regions of the hemispheres. The optic nerves showed but faint signs of a diseased condition, although the left nerve was a little smaller than the right one. Both kidneys were atrophic, weighing 100 grams each, the loss being principally in the cortex.

After proper hardening for the various Nissl, Weigert, Marchi, and other stains, sections of the entire nervous system were made and studied. The results obtained were to a degree remarkable, and for the sake of convenience may be separated into three categories. (1) Lesions appertaining to the blood vessels, (2) those of the proper nerve elements, and (3) those belonging to the membranes surrounding the encephalon and cord.

There being some difference in the intensity of the vascular lesions in the several portions of the nervous system, it is perhaps better to describe the appearances in the several sections in detail. Those of the arteries of the cord being the best defined will be first studied.

The arteries and veins contained in the pia mater are all immensely thickened, but the morbid process varies considerably in its histological characters in different vessels. In the largest arteries, for example, in the arteria spinalis anterior, the intima is approximately normal, while the middle lamina is greatly hypertrophied. In this latter layer the nuclei are too numerous, though few of them correspond in morphological characters to the nuclei of smooth muscle cells. The adventitia shows no alteration either in respect to its nuclei, or to the connective-tissue fibres.

In a few arteries running longitudinally in the cord's envelope the endothelium and fenestrata have separated from the muscularis—probably a post-mortem change—while the latter layer has assumed a coarsely fibrous aspect, and holds but few nuclei of any kind. The fibres making up the former muscular layer are arranged in a convoluted fashion, resembling to some extent the infoldings of a fenestrata, and on a superficial examination the whole layer might be taken for a multiplied membrana elastica. That such is not the case is readily determined by the fact that a perfect lamina is often found internal to the fibrous middle layer.

In a few of the medium-sized arteries, the lumen is completely closed, solely from an overgrowth of the middle layer. The fibrous tissue composing this media shows no evidence of a hyaline degeneration.

The contents of the lumen of such vessels as are not obliterated are interesting. With eosin-hematoxylin or the Van Gieson stain, the whole canal is seen to be filled with a material containing no blood cells, and homogeneous except for a faint granulation. In preparations by other stains, this homogeneous substance is found to contain a few epithelioid cells with round nuclei. Naturally, vessels that are entirely obliterated, or have their lumen filled by a partly organized mass, were in the minority, the greater number having sufficient blood-carrying capacity to perform a portion of their vital functions.

The smaller arteries also present considerable variation in their structural conditions. A majority have walls thickened in the same manner as is present in the larger ones, while with others there is a minor though distinct degree of hyaline degeneration of the middle coat—it now assuming a yellow-brown tint with picric-acid fuchsin. When this hyaline condition is present, the nuclei are sparse and deformed. In a few arteries the elastica is reduplicated, or even quadruplicated, while at the same time the lumen is so narrowed as to be obliterated here and there, or the small opening internal to the intima is filled with a mass of epithelioid cells, in which stainable nuclei are uncommon.

The walls of the larger veins are almost as thick as those of the arteries, but the lumen is dilated rather than narrowed, and often with an irregular outline.

The root fibres of the entire cerebrospinal axis contain numbers of thickened vessels, some patulous, some obliterated. Many of these vessels show a considerable degree of hyaline alteration of the muscularis. Nowhere, however, do the nerve bundles present any considerable augmentation of the connective-tissue elements.

At one point surrounding an artery coursing longitudinally in the meninges, just outside of the external margin of the left Burdach column, lies a nodule of disintegrated round cells, which bears much resemblance to a gummatous neoplasm, which after growing a certain extent had degenerated. The size of this new formation was very small.

The walls of the vessels within the substance of the cord were also greatly thickened, some of those in the anterior horns being visible to the naked eye. Others in the medullated regions are almost equally large. Everywhere there is hypertrophy of the vascular walls, principally of the middle layer and at times it is difficult to distinguish between vein and artery.

The vessels appear to be unduly numerous everywhere; there is no actual new formation of vessels, but the smallest arterioles, even the capillaries, are so thickened as to be unusually prominent in the microscopic field.

This condition of affairs is more especially true for the gray horns than for the medullary tracts. The horns seem to be everywhere strewn with vessels of all sizes, from those noticeable by the unaided eye to enlarged capillaries. The region containing the greatest number of diseased vessels lies lateral, on both sides, to the gray commissure and in Clark's columns.

There was considerable variation in the intensity of the vascular disease in the several regions of the cord and bulb. In the lumbar and cervical levels, while the morbid process was distinct, it had not the same severity as in certain regions of the medulla, and especially in the lower levels of the dorsal cord, where the lesions seemed to have reached their acme of intensity.

The diseased arteries and veins within the nervous tissues have now only one type of alteration. The intima is but slightly affected, a little thickening of the subendothelial tissue being now and then visible, but it is upon the media that the greatest stress of the pathological condition has fallen. This layer is greatly thickened, and presents either a

hyaline or fibrous appearance, according to the intensity and duration of the process, the hyaline degeneration apparently preceding the fibrous change. In some of the vessels the peculiarly shaped nuclei of the muscular structures are to be seen at infrequent intervals, distorted and shrunken to such an extent as to be hardly recognizable. In others no nuclei at all are to be found, and the lamina though fibrous is homogeneous in character. With the Van Gieson stain, the media of a number of vessels takes on a red coloring, but this is diffuse over all the layers, and not confined to the middle one. In still others, the stain acts differently; the intima and adventitia are tinged red, while the muscularis takes only the yellow of the picric acid, and appears not striated but homogeneous.

Externally to the muscularis, lymph spaces are often noted corresponding to local dilatations of the intravascular space. These sometimes contain a few leucocytes. In the adventitia around the altered vessels there is little or no morbid change. It is not unduly thick or fibrous in character, and contains a moderate number of round and oval nuclei. In eosin-haematoxylin preparations a greater degree of intimal involvement is noticeable. There is distinct though slight hypertrophy of the layer, with multiplication to a limited degree of the endothelial cells. The lumina are nowhere closed, though there may be great thickening of the media. The regular ring-like appearance of the lumen is rarely disturbed.

Vascular lesions in the cortex and ganglia of the brain are not nearly so profound as in the cord, though here and there a vessel considerably thickened may be noted, the alteration affecting principally the middle layer.

In the meninges of the encephalon fairly numerous thickened arteries are to be seen. They are not equally distributed everywhere, but occur locally. The points of selection in the basal regions for the most altered vessels are in the nerve roots, and especially in the arteries lying between the nerve bundles. In nearly all of the cranial nerves several of these pathological vessels are to be seen, though it is only rarely that a degenerated nerve fibre is to be discovered near them, with the exception of the optic nerve tracts where all the fibres have atrophied.

The arteries of the *integument* showed precisely the same lesions as those of the cord and meninges. In some the morbid process is more extensive than in others, and pronounced hyaline changes in the media are noticeable. The muscular nuclei have for the most part disappeared. The endothelial and subendothelial structures are slightly hypertrophied.

Lesions of the nerve elements varied in direct concordance with the severity of the vascular disease, reaching their acme in the lower portion of the dorsal cord and in the medulla. There was a subsidence of the acuity of the process in the upper region of the cord and in the cortex cerebri. All the changes of a pathological nature were strictly of an atrophic order, and of these the fatty pigmentary degeneration of the cells was the most prominent. Of secondary importance was a condition of simple atrophy of the entire nerve body with shrinkage of the protoplasm and nucleus. The lesions of the conducting fibres were also entirely of a degenerative type.

Throughout the cord, but especially in the dorsal region,



many of the cells in the gray horns were completely filled with coarse yellow pigment grains, among which a shrunken nucleus is now and then discernible. No nucleolus is visible in the atrophied vesicles. In rather infrequent instances the nucleus is pushed to the periphery of the cell. The cells of the columns of Clark seem to have suffered more severely than elsewhere.

In those cells in which the accumulation of pigment is not so considerable, the Nissl bodies are coarse, do not retain their regular arrangement in the protoplasm, but are irregularly distributed throughout the substance. At times these granula also show a tendency to group themselves together at the periphery of the cell-body, leaving a clear ring of considerable extent around the neighborhood of the nucleus. In still other nerve bodies there are scattered clumps of granula in the protoplasm, with large spaces in between devoid of any stainable substance. Lying among these better preserved cells are others that are shrunken to a mass of fine granular material in which neither nucleus nor nucleolus is visible.

The state of the nucleus varies considerably in the least damaged cells. In a majority the karyoplasm and chromatin particles are natural, but there are also a variable number in each section in which the vesicle has the appearance of being swollen, and the nuclear substance is unstainable. In a very few instances there is a double nucleolus marking the presence of an irritative process.

In the upper cervical enlargement and medulla the state of the cells was almost precisely similar to that at the lower levels, though a larger proportion shows a normal arrangement by the Nissl methylene blue. In a considerable number the protoplasm is filled with masses of yellow pigment, which sometimes covers and obscures the nucleus. The irregular disposition of the Nissl bodies in some nerve elements is shown with great distinctness, but in others the granula are diffused throughout the cytoplasm, and their ordinary appearance is lost. Quite a number of the nuclei exhibit a shrinkage of their volume and irregularity of contour. The vesicle also has a tendency to retire to the periphery of the protoplasm.

In the medulla, there were cells among the scattered nuclei on the floor of the ventricle that showed displacement and distortion of the cell-nuclei, but pathological cells on the whole are not common, and few of the nuclei of origin of the cranial nerves contain any considerable numbers of them.

In the higher regions of the medulla oblongata the cell-nuclei are much more frequently displaced than lower down, and the bodies of the cells show greater atrophy. In the region lateral to the V-shaped point of the ventricle there are numerous heavily pigmented cells. The entire cytoplasm is now filled with it, and the nucleus is no longer visible. Some of the nerve elements are in process of disintegration, and double nucleoli are by no means infrequent within the nuclear ring. The morbid process is most marked in the nuclei of origin of the X, XI and XII cranial pairs. Corresponding with the degree of cellular degeneration there is here an advanced degree of arterial disease.

In the anterior portion of the medulla the superior olivary bodies show a pathological state, in that their cells contain heavy masses of pigment equally diffused through the bodies.

Elsewhere the accumulation of metaplastic material can hardly be said to be greater than is ordinarily found in persons of somewhat advanced age. The Nissl bodies are fairly well stained in such cells as are not considerably pigmented. The cells of the glossopharyngeal nucleus have less pigment in them than any other nerve elements of this region.

At the level of the pons the cells of the nucleus acusticus dorsalis are filled with metaplastic granules; all others are freer from the accumulation of grains than in the medulla. The nuclei in the cells of the acusticus are displaced, and the outlines of the vesicles are indistinct.

Few changes can be determined among the nerve bodies of the cerebellum, and the vascular lesions are correspondingly slight.

In the cortex the quantity of the pigment granules in the pyramidal cells was not above the normal, and is not diffuse but confined to one corner of the cell. The nuclei and nucleoli are perfect. The cells of the corpora striata and lenticular bodies were a little more pigmented than those of the cortex owing to the more extensive vascular implication.

Taking into consideration the severity of the vascular lesions and the degree of pigmentary atrophy of the protoplasm of the nerve bodies consequent thereto, there is singularly little degeneration of the medullated portion of the neurone, and when it does occur, it is only where the vascular disease has reached its maximum of intensity. But two of the cranial nerves showed any varicosity or atrophy of the nerve fibres. The gray degeneration of the optic nerves had apparently long antedated the other lesions, being far more advanced. Few medullated tubes in the tracts showed any blue-black coloring with the Weigert stain, and all were atrophied; yet there was a very trivial thickening of the interstitial connective tissue between the bundles of fibres, and no multiplication of the fixed nuclei. The degeneration of the fibres among the bundles of the hypoglossal nerve was limited to a single strand, and was probably a direct consequence of the occlusion of an artery that ran longitudinally through it.

The examination of the root fibres of the superior portions of the spinal cord was negative. In the dorsal region a greater number than usual of small medullated tubes were discovered, and some of these were blackened by the Marchi stain, but altogether the number was inconsiderable. No varicose fibres were to be seen anywhere.

Within the substance of the cord, two sclerotic tracts, both of small size and among the ascending fasciculi were found. The lumbar cord was free from any trace of medullary degeneration, and it was not until the level of the ninth dorsal vertebra was reached that any disease of the white columns became manifest. At this level, a small area of degenerated fibres first becomes visible, situated in the right column of Burdach in close proximity to that of Goll. The area occupied is very small. It was at first entirely separated from the pia, but soon approached it more closely, and finally touched the margin. The form of the degenerated tract was irregularly pyramidal, the base broad, lying upon the external margin, the apex, sharply defined, penetrating more deeply. Nearly all of the nerve tubes within this area are atrophied,

with here and there an enlarged axis cylinder among them. This degenerated zone disappeared entirely before the cervical enlargement was reached.

A few millimetres above the beginning of the first degenerated tract (at the level of the lowermost border of the seventh dorsal vertebra), a new area of degeneration was noticed, this time in the left postero-lateral column. At first it appears under a magnification of 80 diameters, as a circular patch not larger than the head of a pin, lying close to the Lissauer zone though not within the indirect pyramidal tract, and well separated from the external border of the cord. Very shortly it enlarges, and assumes a wedge-shaped form, having its broad base on the external border of the cord, and its apex turned towards the deeper regions. It now lies well within the direct cerebellar fasciculus.

In the lower cervical region, the sclerotic area broadens, and at the same time moves from the posterior part of the column to a position almost in the middle of the lateral region, now occupying a place along the posterior edge of the Gower's tract. The irregular wedge-shape is retained throughout this region, the borders of the degenerated being sharply defined from the normal tissue.

In the uppermost region of the cervical cord, the sclerotic zone again moves slightly forward (ventrally) until it comes almost directly into the Gower's tract, then at the level of the lower portion of the pyramidal decussation it decreases perceptibly in size, and at length becomes reduced to a narrow band along the anterior border of the cord, completely within the Gower's bundle.

The sclerotic tract now rapidly decreases in size until it is finally lost at the level of the uppermost portion of the decussation, no degenerated fibres being found in the direct cerebellar tract or extending in the direction of the nucleus lateralis. The cells of this nucleus are numerous, not atrophied in the least, and do not differ in any way from those in the adjacent nuclei of origin of the nerve roots. Sections carried through the medulla and pons failed to show any further degenerated tracts. From the lowermost dorsal to the level of the lower cervical enlargement, the fibres contained in the posterior commissure were much less numerous than usual.

Except in the sclerotic fasciculi, an examination of the neuroglia cells failed to show any participation on their part in the morbid process. While in places about the root fibres of the nerves or origin, the pia was to some extent thickened, this alteration was never considerable, and what thickening there was of the membrane was dependent upon an hypertrophy of the fibre elements and not upon multiplication of round cells.

To recapitulate:—The fundamental pathological basis for the various nervous phenomena described in the clinical history of the case is as follows: (1) A hyaline-fibrous degeneration of the arterial system existed, which was not confined to the central nervous regions, but was equally evident in the roots of the spinal nerves and in the skin tissues. The degree of alteration varied from slight thickening of the muscular layer to complete closure of the lumen from hypertrophy of the middle coat of the vessel walls. The morbid change was

accordingly not uniform, but reached its maximum of intensity in the vessels of the lower dorsal cord, the meninges of the bulb and cord, and also in certain of the root bundles of the cerebro-spinal nerves. (2) As a consequence of the vascular lesions there were degenerations of an atrophic order in the nerve cells of the gray horns of the cord, more particularly in those of Clark's column, and in the medulla oblongata. To this alteration in the central nervous substance at least a portion of the various symptoms must be attributed.

Besides the principal lesions there were others of considerable, though minor importance.

The degeneration of scattered fibres in the bundles of the spinal and bulbar nerves played some part in the general symptomatology, being shown during life by the lowering of tone as regards the innervation of the muscles, as well as by disturbances of the functions of the nerves extending from the terminal apparatus.

The sclerosis of a portion of the outer zone of Burdach's column would signify that fibres ascending through the posterior root zones were degenerated, though the small area involved shows that their numbers were inconsiderable. The lesion of the tract itself has but little significance, the fibres involved belonging to short inter-connecting bands.

The lesion of the direct cerebellar tract is not only of more importance, but presents some rather peculiar features. The absence of the majority of the medullated fibres from the posterior commissure, over considerable regions of the medulla spinalis, favors the view that a portion of the cerebellar bundle is formed from the fibres of this commissure. The gradual change of position in the sclerotic area shows also that the fibres—at least in this instance—do not proceed directly upward in the column, but are gradually diverted as other fibres enter, and assume a more and more anterior position; and, furthermore, that a portion of the fibres are lost in the upper cervical and lower regions of the medulla and do not proceed to higher levels. This ending of the ascending fibres has been ascertained for a part of Gower's bundle, but is not usual in the case of the component medullated fibres of the direct cerebellar tract. At its beginning, the degenerated area almost touched the left posterior root zone, while in the upper cervical region it verged upon, if it did not enter, the area assigned to Gower's bundle. The total disappearance of the degenerated area at the lowermost level of the medulla may be considered to have sufficient anatomical value upon which to base the theory that in the so-called direct cerebellar tract other fibre bundles, which are at present unknown, enter into its formation, and that these correspond more closely, in their manner of termination, to the bundles of the Gower's system than to those of the cerebellar paths. The deportment of the sclerotic fasciculus may also give rise to the supposition that we have to do more here with an undescribed bundle, running from the dorsal to the uppermost cervical region.

As an explanation of the numerous symptoms of the case, it would appear most reasonable to suppose the existence of a disease-process affecting simultaneously both the peripheral and central nervous systems. Assuming that the arterial lesions were of late specific origin—and of this there can be



but little reasonable doubt—a chronic progressive involvement of the nutrient channels, here and there leading to marked narrowing or even to closure of isolated vessels, might certainly have produced just such a train of symptoms as was present. Of primary importance would be the involvement of the arteries of the anterior and posterior nerve roots of the bulbo-spinal system, though the direct lesions of the nutrient supply to the terminal nerve apparatus—which have to be inferred as they could not be definitely determined—would be of equal value. This inference of the implication of the end-apparatus is justifiable, since the arterial degeneration in the skin was quite extensive, and whenever there is starvation of a nerve tissue there result pathological reactions which may be manifest in a multitude of ways.

The slowly progressive character of the symptoms is also consistent with the theory of tissue-starvation. All the lesions of the nerve cells of the cord and bulb are of this type—atrophy and pigmentary degeneration from malnutrition. Whenever nutrition is at a low ebb, metaplastic granules accumulate in the protoplasm of the cell.

The condition of the optic tracts—in which the lesions are identical with those of other nerve roots except that they are more advanced—would argue that the thickening of the blood-vessels was of long standing, and that only when the process had advanced to an extreme degree did any definite symptoms show themselves. This is exemplified more particularly in the state of the cortex cerebri. Though in this

region vascular disease was manifest and diffuse, it had not advanced nearly to such an extent as in the gray matter of the dorsal cord or in the adjacent meninges. As a consequence, the functions of the cortex, while not as perfect as in youth, were not reduced to the same low level as those of the cord and bulb.

One pathological fact should be remembered in considering the clinical symptoms, namely, that it is not necessary for a vascular lesion to proceed to such a profound degree as to cause the entire shutting off of the nutrient supply before a nerve tissue will show signs of deviation from its normal functions. With a reduced supply of nutrient plasma, definite manifestations of nervous exhaustion are brought about, and these are not due to a degeneration of the component portions of the neurone which is visible in the tissue after death, by our present methods of preparation, in the form of morbid alterations of the cytoplasm, axone or myelin. Long before this stage is reached the entire neurone is incapable of performing its natural functions in an efficient manner, and as a consequence, anæsthesias, paræsthesias, diminution or exaltation of the reflexes, and dulling of the special senses can be noted. Almost precisely similar results are encountered in advanced stages of progressive paralysis, especially in the syphilitic cases in which, when vascular lesions of the arteries of the cerebrum and cord have advanced to a profound degree, there is a gradual but progressive dulling of cutaneous sensibilities and special sensations.

## CONGENITAL MALFORMATIONS OF THE HEART AS ILLUSTRATED BY THE SPECIMENS IN THE PATHOLOGICAL MUSEUM OF THE JOHNS HOPKINS HOSPITAL.

By W. G. MACCALLUM, M. D., *Assistant in Pathology.*

The literature on the congenital malformations of the heart is very extensive, but is well represented by the works of Rokitsky,\* Peacock,† Rauchfuss‡ and Vierordt.§ That of Rokitsky, dealing with the defects of the septa, is, perhaps, the foundation of our accurate knowledge of these anomalies, while Rauchfuss, Peacock and others have added greatly to the observations of anomalies of the heart in general, and have done much to determine their relations to one another. Vierordt, writing in the light of the more recent embryological work of His and Born, presents the whole subject in the most concise and lucid way.

The following is intended to be a brief synopsis of the various malformations to serve as the legend to the photographic illustrations which are taken from the specimens in the pathological museum, and also in a way as a catalogue of those specimens:

\* Rokitsky: *Die Defecte der Scheidewände des Herzens.* Wien, 1875.

† Peacock: *On malformations of the human heart, with original cases.* London, 1852.

‡ Rauchfuss: *Die angeborenen Entwicklungsfehler des Herzens.* Gerhardt's *Handb. d. Kinderkrankh.* Tübingen, 1878. Bd. IV, 1 abth.

§ Vierordt: *Die Angeborenen Herzkrankheiten.* Wien, 1898.

A.—*Open foramen ovale.* This is perhaps to be considered a malformation only when the defect is large, as it is so extremely common to find a small interauricular opening well guarded by the *valvula foraminis ovalis*. Even when widely open in persons who have reached adult life, the symptoms it produces are indefinite or none. It may occur pure or in association with a variety of other defects. The symptoms are more definite when it is associated with mitral insufficiency, for there is then pulsation of the veins of the neck. The so-called paradoxical embolism is the result of the passage of the embolus through the open foramen into the systemic arteries, by which means the sifting-out action of the pulmonary circulation is avoided.

FIG. 1 shows a glass rod passed through the foramen ovale. The fossa ovalis in this case is deep and the *valvula foraminis ovalis* bulged into the left auricle. It was, however, able to completely close the opening.

B.—*Defects in the septum ventriculorum.* Rokitsky considered the *pars membranacea* as derived from the ventricular wall, while more recent writers trace its origin to the aortic septum; defects in the septum are most commonly in this small area, the “undefended space” of English writers. They may, however, be at other points in the septum, seldom near the apex. The defect seldom occurs pure, but is oftenest associated with narrowing of the pulmonary orifice. Cyanosis



appears when the pulmonary is narrowed (Roger's disease), and there is generally a single, loud, constant murmur in the upper median præcordial region, beginning in systole and covering both sounds. The absence of a murmur in diastole is explained by the covering of the defect by the tricuspid and mitral valves.

Aneurismal dilatation of the membranous portion of the septum may occur, the saccular projection appearing in the right ventricle underneath the tricuspid leaflet to which it is often attached. This sacculum may be actually perforated, but neither of the two specimens in this collection shows this perforation.

The origin of this condition is variously explained as being due to arteriosclerosis, differences in intracardiac pressure, and traction by the adherent tricuspid leaflet.

FIG. 2. The pars membranacea septi is pierced by a round hole about 1 cm. in diameter. The pulmonary orifice in this case was narrowed by a thickening and contraction of the valves.

FIG. 3. The pars membranacea septi is in this case bulged into the right ventricle, forming a saccular projection beneath the tricuspid valve. The mouth of this sac is seen just below the aortic valves.

C.—*Stenosis of pulmonary.* This is the commonest of the malformations of the heart. It is explained as due either to abnormal division of the truncus arteriosus or to congenital inflammatory disease. The narrowing may occur in or above the valves, by the constriction of a fibrous ring in the artery or lastly by a constriction in the conus.

It is often associated with defects in the septa. The right ventricle is hypertrophied unless the pulmonary is completely atresic and the septum ventriculorum closed.

Clinically there is cyanosis with various sounds on auscultation, none of which are typical. Often there is a loud systolic murmur in the 2nd and 3rd left interspaces. The 2nd pulmonary sound may be weak, but is strong if the ductus arteriosus is widely open.

The so-called "Rechtslage" is a condition in which extreme narrowing of the pulmonary orifice is associated with a wide defect in the septum ventriculorum and a shifting of the aortic orifice so that it opens directly over the septum and thus communicates with both ventricles.

FIGS. 4 and 5. "Rechtslage." A, stenosed pulmonary orifice; B, aorta opening into each ventricle; C, mitral, and D, tricuspid orifice. In Fig. 5 a rod is passed through the left ventricle from its apex into the aortic orifice. The figure shows the aortic orifice as seen through the right ventricle.

As regards the general idea that tuberculosis of the lungs is especially frequent in cases of pulmonary stenosis, it is found by a consideration of the statistics that while tuberculosis is frequent in these cases it is not relatively more so than in the other conditions (of heart and general) that produce a predisposing depression of the nutrition of the pulmonary tissues.

D.—*Anomalies in the division of the truncus arteriosus.*

1. Persistence of truncus due to a failure of division.
2. Stenosis or atresia of the pulmonary from the defective course of the dividing septum.
3. Transposition of the arterial ostia.

Rokitansky's classical work on the transposition of the arterial trunks has lent a great theoretical interest to this group; but as the collection contains no representative, no illustration is given. With transposition of vessels we may have the vessels opening from their proper ventricles or from the opposite ventricles, this depending on the behavior of the septum membranaceum, which by a change in its relations may correct the anomaly. There is generally extreme cyanosis, but this may be prevented by a widening of the bronchial arteries.

E.—*Anomalies in the semilunar valves.* Anomalies in the semilunar valves occur more often at the pulmonary orifice than at the aortic. At either orifice there may be but two segments, or on the other hand there may be four or five. They have been explained as due to an excess of the endothelial cushions which go to form the valves.

F.—*Anomalies in the aorta.* The ductus arteriosus may persist as an open communication between the arterial trunks with hypertrophy of the heart. No cyanosis and sometimes a systolic murmur in the 2nd left interspace.

Stenosis or obliteration of the aorta near the entrance of the ductus arteriosus is not uncommon. The stenosis assumes various forms and relations to the position of the ductus—the point of predilection is in the isthmus aortae. The pulmonary is dilated and the arch of the aorta and the arteries springing from above the structure greatly widened. Collateral circulation to the lower portions of the body is effected by anastomoses between the internal mammaries and intercostals. The pathogenesis of the condition is rather obscure. The process is by some thought to be an extension of the obliterative changes going on in the ductus.

There is seldom cyanosis; sometimes œdema; the superficial arteries become tortuous and pulsate visibly, there is inequality in radial and femoral pulse and often a systolic murmur varying in its location.

FIG. 6. Stenosis of aorta (B) just below entrance of ductus arteriosus (C). A is placed upon the widened pulmonary artery. The specimen shows great dilatation of the arterial branches and arch of aorta above the stricture.

G.—*Anomalies in the auricular ventricular valves.* The remaining anomalies are chiefly those affecting the tricuspid and mitral valves, and these cases are so rare that it is difficult to make any general statements concerning them.

The representative of this group in the collection is so curious that it seems to deserve to be reported in some detail.

The case was that of an artist who had always been blue and who died at the age of 30 of pulmonary tuberculosis. At the autopsy there was found to be a chronic tuberculosis of the lungs, with chronic passive congestion of the viscera. The heart was enlarged, the enlargement being especially in the right side. The Eustachian valve is found to persist as a large apparently functional valve. The valvula foraminis ovalis also persists, but is not competent to close the foramen ovale, which is open to a width of about 1 cm. The very large appendix auriculæ opens by two mouths into the auricle, which is somewhat constricted near its middle by a muscular ring.

The tricuspid valves are ballooned out into the right ventricle and have apparently become closely grown together with the ventricular wall. Two of the segments are visible against the interventricular septum and toward the left—these are wrinkled and folded membranes, which are very soon fused with the ventricular wall and are apparently functionless. The remaining segment seems to furnish the whole membrane which lines the ventricular wall and septum; and below, roofing the trabeculæ, forms the floor of a sort of intervalvular chamber. This chamber opens into the ventricle through a round opening, situated toward the left, just below the conus arteriosus and guarded by a flap-like fold of the chamber wall. It further opens through several small openings, each guarded by tiny valves which are furnished with chordæ tendinæ and papillary muscles. The pulmonary artery is slightly narrowed, and the ductus arteriosus persists as a cord, but otherwise the heart is approximately normal.

Ebstein \* has reported a case in which the malformation of the heart coincides in every detail with this one, and although no other such cases are reported the recurrence of the malformation in every detail suggests in a way that cannot be ignored the existence as a cause of a definite sequence of events. A possible explanation is as follows: The valves are, of course, formed on the medial side by a prolongation from the septum intermedium—on the lateral side by an involution of the wall of the auricular canal. If in an early stage these endothelial cushions reach a greater extent than normal, and retain their attachment to the muscular trabeculæ, they would in time become a membrane, supported by muscular trabeculæ. This might occur only on the lateral side, the

valves produced from the septum, developing in part normally. The free edge has possibly lost its muscular attachment as a result of the inefficiency of muscular action in the direction in which the blood stream affects it.

The association of pulmonary tuberculosis with this malformation (also observed in Ebstein's case) is interesting in connection with what was said above as to pulmonary stenosis. Naturally the effect of such an insufficiency of the tricuspid—for the mere presence of a large inner chamber, acted upon by the contraction of the ventricle, but not guarded from the auricle constitutes an insufficiency—is the same as that of the pulmonary stenosis in producing a poor nutrition of the lung tissue. The compensating persistence and development of the Eustachian valve is also to be noted.

FIGS. 7 and 8 illustrate this malformation. FIG. 7 shows the right auricle and ventricular portion of the heart laid open. The open foramen ovale (A), and the two mouths of the auricular appendix are readily seen; B points to the large round opening into the ventricle; C, the apical portion of the functional ventricle; D, the medial leaflets of the tricuspid valve.

In FIG. 8, the conus arteriosus pulmonalis is laid open, showing the larger portion of the functional right ventricular cavity with the opening B just below the pulmonary orifice and guarded by the flap-like valve.

In connection with several malformations, it may be stated that the theories as to their origin, ascribed them formerly either to a true congenital malformation, or to a foetal endocarditis. The majority of authors, however, now lean to the view that the rôle of foetal endocarditis is relatively unimportant, and that the vegetations so often seen on malformed valves, on the edges of septal defects, etc., are to be explained as the result of the predisposition of such malformed parts to inflammatory processes.

\* Ebstein. Arch. f. Anat. and Phys., 1866, S. 238.

## SUMMARIES OR TITLES OF PAPERS BY MEMBERS OF THE HOSPITAL AND MEDICAL SCHOOL STAFF APPEARING ELSEWHERE THAN IN THE BULLETIN.

THOMAS R. BROWN, M. D. Internal Medicine.—*Maryland Medical Journal*, February, 1900.

ROBERT REULING, M. D. Pathology.—*Maryland Medical Journal*, February, 1900.

HUGH H. YOUNG, M. D. Surgery.—*Maryland Medical Journal*, February, 1900.

WILLIAM OSLER, M. D., and THOMAS McCRAE, M. D. Latent Cancer of the Stomach.—*Philadelphia Medical Journal*, February, 1900.

HENRY J. BERKLEY, M. D. General Pathology of Mental Diseases.—*American Journal of Insanity*, January, 1900.

HENRY J. BERKLEY, M. D. Transitory Alienation Following Distressing Pain.—*American Journal of Insanity*, January, 1900.

WILLIAM OSLER, M. D. After Twenty-Five Years.—*Montreal Medical Journal*, November, 1899.

PATRICK CASSIDY, M. D. Report of a Severe X-Ray Injury.—*Medical Record*, February 3, 1900.

IRVING PHILLIPS LYON, M. D. The Inoculation of Malaria by the Mosquito.—*Medical Record*, February 17, 1900.

LEWELLYS F. BARKER, M. D., and JOSEPH MARSHALL FLINT. A Visit to the Plague District in India.—*The New York Medical Journal*, February 3, 1900.

## THE JOHNS HOPKINS HOSPITAL BULLETIN.

The Hospital Bulletin contains details of hospital and dispensary practice, abstracts of papers read and other proceedings of the Medical Society of the Hospital reports of lectures, and other matters of general interest in connection with the work of the Hospital. It is issued monthly.

Volume XI is now in progress. The subscription price is \$1.00 per year. The set of ten volumes will be sold for \$20.00.

## PROCEEDINGS OF SOCIETIES.

## THE JOHNS HOPKINS HOSPITAL MEDICAL SOCIETY.

Monday, February 5, 1900.

The meeting was called to order by the President, Dr. H. M. Thomas.

**Exhibition of Patients.**—DR. W. B. PLATT.

CASE 1.—Infant, seven months old, came to the Garrett Hospital when five months of age with a sinus just below the right eye and a history that pus occasionally escaped from the right nostril. An examination showed an empyema in the right antrum with necrosis of the bony wall in at least two places. The sinus above had caused contraction of the lower eyelid. There is also an opening into the nose apparently one-eighth inch in diameter. I removed a molar tooth as the best way of getting a free opening into the antrum to clean it out. The child improved immediately, the sinus above healed up, and the discharge was not more than a drop a day, and the child was sent home. A small piece of necrosed bone was also removed from the alveolus.

The child returned in seven weeks with the history of a recurrence. Pus now escapes through the right nostril and from the sinus below the right eye. I do not find any record of cases similar to this in infants, and the exact cause is not clear. It may be an osteomyelitis. The probability is that there was an abnormally large opening from the antrum into the nose which became infected during child-birth, with subsequent involvement of the delicate bone wall.

CASE 2.—This boy, seven years old, has a curious defect, a hole  $\frac{1}{4}$  inch in diameter in the palatoglossus muscle of the left side. There is every reason to believe that it is a congenital defect. Of course, one may suppose it a case of congenital or inherited syphilis, but in view of the frequent defects in the development of the soft palate, it is probably one of this kind.

CASE 3.—This is a case of congenital hip-joint dislocation. The girl, six years old, was sent to the Garrett Hospital from Virginia, with the history that she had always limped, and became fatigued on prolonged exertion. An examination of the right limb will show you that it is not hip-joint disease. She has perfect mobility, not the slightest hampering of the movements of the limb and no bowing up of the lumbar region on flexion of the thigh on the pelvis. On first looking at it I thought of infantile paralysis, because the whole limb is somewhat atrophied in appearance as compared with the other. The distance from the right anterior superior spine to a horizontal line drawn through the right trochanter is three-quarters of an inch less than corresponding measurements on the left side. On drawing down the right thigh limb and letting it go we get a distinct, though slight, telescoping.

What is to be done with children of this sort? If the telescoping amounts to three or four inches, if the gait is very bad, or fatigue or pain follows moderate exertion, an operation must be done. Statistics show that after two or three years the hip in many cases again telescopes. A man of large experience has said that fifty per cent. of the operated cases relapse. This little girl walks and runs so well that we

have tried only massage to increase the strength of the gluteal muscles. Some cases have done well by use of the ordinary hip-joint apparatus to keep the hip extended and pressed into the socket for some months. A certain number of these cases never have anything more than a slight limp.

**Changes in the Cells of the Nucleus Dorsalis resulting from Pressure upon the Upper Portion of the Spinal Cord.**—DR. BARKER.

The specimen is from a case of compression of the upper part of the thoracic cord, the section being taken from the lower part of the thoracic portion. It will be recalled that the thoracic portion of the cord is characterized by the presence of a column, or nucleus, of gray matter on each side called Clarke's nucleus, or the nucleus dorsalis. The cells in this nucleus, give off axis-cylinder processes which run out into the dorsolateral region of the cord and then turn upward, ascending through the cord to the cerebellum, the whole bundle being known as the fasciculus spinocerebellaris dorsolateralis, or direct cerebellar tract. If one cuts through a medullated axone, there result changes in the whole neurone. If the axone of a neurone be cut anywhere between its cell-body of origin and the end of its axis-cylinder process, the nucleus becomes displaced in the cell-body, assuming an eccentric position, usually very close to the axone hillock; in addition to this change the tigroid masses, or Nissl bodies, break down into very minute granules, like fine dust, which become diffused through the cell. If the ulnar nerve, for example, be cut, one finds in the spinal cord that all the cells which give origin to the fibers of the ulnar nerve show this peculiar form of degeneration—so-called "reaction at a distance." If then the cells of Clarke's nucleus send their axones to the cerebellum, we should expect, in compression of the upper thoracic cord, to find this change below the lesion, in all the cell-bodies which send their axis-cylinder processes to a part of the cord above the lesion. Accordingly sections from this cord below the lesion ought to show degeneration of the cells of Clarke's nucleus. The specimen under the microscope illustrates the alterations well. The cells show the change described in varying degrees of intensity. I have before pointed out the occurrence of similar changes in the nucleus dorsalis in inflammations of the soft meninges (*Brit. M. J.*, Lond., 1897, ii, pp. 1839-1841). The superficial position of the fibers of the direct cerebellar tract makes it especially liable to injury.

**Area of Necrosis in Internal Capsule in Typhoid Fever.**—DR. BARKER.

It was not easy to make out the lesion when the brain was first cut up. The brain was put into formaline immediately after its removal and was divided by the method of Petri some days later. On cutting through the brain it was found that the formaline had not penetrated the whole substance of each hemisphere, there being a large area that was soft. No definite area of necrosis was made out. In view of the marked clinical symptoms it seemed necessary to keep the tissue of



the right side for microscopic examination. These pieces were put back into the formaline in order to complete the hardening.

The hardening has now become complete and the lesion is perfectly well-defined and easily visible. It is an area of softening in the upper part of the right internal capsule, about the size of a small hickory nut, situated just lateral from the caudate nucleus a little medial and slightly dorsal from the upper border of the cortex of the island of Reil.

The necrosis must have involved practically all of the fibers of the pyramidal tract on the right side, and is undoubtedly due to a plugging of a branch of the artery supplying the area. The tissue is to be thoroughly worked up microscopically, but it seemed to be worth while before cutting the pieces into sections that the gross lesion should be presented to the Society.

#### Poisonous Snakes.—DR. KELLY.

Dr. Kelly concluded his demonstration of the poisonous snakes of North America by exhibiting: 2 specimens of *Elaps fulvius*, one of which had caused the death of a man by biting him in the hand; 1 boa constrictor (young) showing remarkable difference from native snakes in the fine bead-like appearance of the body due to the scales in 83 rows, and the peculiar pear-shaped head also covered with minute scales; 1 *Sistrurus miliarius*, or ground rattlesnake; 2 large diamond-back rattlesnakes; 1 living moccasin, *Trigonocephalus piscivorus*; 1 mountain blacksnake, *Bascanium constrictor*; and casts of snakes made by Mr. John W. Thompson, of the Philadelphia Zoological Gardens, one finely colored Texas copperhead, one very large diamond-back rattlesnake, and one very large moccasin.

#### NOTES ON NEW BOOKS.

An Experimental Research into Surgical Shock. By GEORGE W. CRILE, A. M., M. D., Ph. D. Svo. pp. 160. (*Philadelphia: J. B. Lippincott Company*, 1898.)

Due mainly to the leadership of the German and French schools of pathology, the research work of most surgical laboratories in this country to-day is devoted largely to the investigation of problems which the comparatively modern subjects of pathological histology and bacteriology have offered for solution. In consequence it has gradually come about that the methods of investigation best known to the physiologist have fallen into abeyance in spite of the valuable data relative to surgical principles which may be obtained by their employment. Prompted by some preliminary research conducted in the laboratory of his quondam preceptor, Mr. Victor Horsley, Dr. Crile, making use of physiological methods of experimentation, has undertaken an investigation concerning the nature of surgical shock; a subject which has always been somewhat nebular in its indefiniteness and offering problems the solution of which can only be approached by employing these methods.

The results of this excellent piece of work are comprised in a small volume of 160 pages which received the Cartwright Prize in 1897.

The essay represents the results of entirely personal observations, and in this lies, perhaps, the chief occasion for congratulation; and yet, on the other hand, for criticism of the author's published work, the value of which, considerable as it now stands, would have been

greatly enhanced as a book of reference had the bibliography of the subject been given, and the comparative results of other investigators in the same direction been cited. A cursory review of the theories of shock advanced by various writers is contained on the introductory four or five pages of the volume without references to the articles which have evidently been consulted.

After a brief description of the "Modes of investigation and annotation" which, though original with the author, are those commonly employed in the physiological laboratory, the chief part of the essay (100 pages) is given up to the detail of the individual protocols of the 148 experiments upon anesthetized dogs.

In these experiments, observations were made of the effects upon the respiratory, cardiac and vascular mechanism of all conceivable forms of traumatism upon the individual tissues and organs of the body, somatic, splanchnic and neural. These experiments evidence the author's thoroughness and ingenuity, and though their record, from necessary repetition, makes the protocols uninteresting reading, an excellent index renders it possible to abstract data from them, otherwise buried in the mass of material, which will be of value to those pursuing similar lines of investigation.

The author has given an interesting summary of his experimental findings in the latter part of the volume, with 35 composite charts of manometric readings, illustrating the effects produced upon the blood pressure by the various experiments. These included procedures showing the rise in blood pressure consequent upon burning the skin, injuries of the periosteum, dilatation of the sphincter ani, etc.; procedures showing the negative effect of certain manipulations, as upon the joints: procedures showing the great "depressor" effect of cutting away the cerebral hemispheres, of manipulation of the larynx, the testicle, the parietal peritoneum, the intestines, etc. It was furthermore demonstrated that when an animal was exhausted, as late in an experiment, and with shock present or pending, the application of stimuli, ordinarily producing a temporary rise in blood pressure, under these circumstances would be followed by a fall.

Possibly, from a practical standpoint, the most valuable suggestions from Dr. Crile's work originate in the results of his observations upon the "blocking" effect of the preliminary local administration of cocaine as a preventive measure toward shock in anticipation of those peripheral manipulations which ordinarily have a marked depressor effect. This is most strikingly shown in one of the composite charts (near page 127. These charts unfortunately are not numbered) which illustrates the great fall in blood pressure which ordinarily follows upon manipulations of the larynx, and the inhibitory effect of preliminary cocaineization of the mucosa upon this fall.

As prophylactic measures toward shock the author emphasizes the necessity of careful hæmostasis under all circumstances; of atropine in operations on the larynx or in procedures which might cause mechanical stimulation of the vagi; of a proper respect for tissues and the avoidance of tearing or finger dissections unfortunately used by many operators. Precautions toward over-anæsthetization, especially with chloroform, are dwelt upon as most likely to occur in those operative procedures which are associated with an acceleration of the respiratory rate, and in abdominal, anal and other operations. Emphasis is also laid upon the likelihood of shock, in consequence of operations in the gall-bladder or pyloric region, due to pressure on the venous trunks, diaphragm and splanchnic nerves. He truly says, "The severity of shock produced in abdominal operations is in direct ratio to the distance from the pelvis."

Dr. Crile offers nothing new in the matter of treatment, believing that small and frequently repeated hypodermic injections of strychnia and intravenous saline infusions to be the most efficacious measures, with elevation of the lower extremities, application of heat, etc. Emphasis is rightly given to the fact that intelligent prevention is more valuable than treatment.

In the etiological factors producing shock the author does not seem in his views to differ widely from the theories proposed by Fischer, Goltz and Seabrook. An attempt is made to differentiate *collapse* and *shock*, the latter being regarded as especially dependent upon "vasomotor impairment or break down," the degree of shock being proportionate to the failure of the pressor action. Factors, cardiac, respiratory and hemorrhagic, may add to shock, or, if their effects are severe and immediate, may produce collapse. Certain widespread vasomotor action, as that following section of the splanchnic nerves, may, however, produce the same condition.

Dr. Crile's work is important in the effect it will have in stimulating investigation of surgical problems on physiological lines. It is to be hoped that observations by the methods of Nissl will be made upon the histological changes in the medullary nerve centers and ganglia responsible for these vasomotor disturbances, and also that mercurial manometers, constructed so as to be applied to the extremities, may be employed in surgical operating-rooms for the purpose of recording vasomotor effects and changes in blood pressure, and to indicate impending shock more definitely than at present is possible through the medium of the anæsthetizer's finger on a peripheral artery. CUSHING.

**Essentials of Diseases of the Skin, including the Syphilodermata, arranged in the form of Questions and Answers prepared especially for Students of Medicine.** By HENRY W. STELWAGON, M.D., Ph.D., Clinical Professor of Dermatology in the Jefferson Medical College, etc. Fourth Edition, thoroughly revised. Illustrated. (Philadelphia: W. B. Saunders, 1899.)

In the present edition, the whole book has been subjected to careful scrutiny and revision, and the text has undergone numerous small but important changes in order that it may reflect the present state of knowledge of cutaneous diseases. The rarer affections like hydroa vacciniforme, blastomycetic dermatitis, and erythema induratum are briefly but adequately described. The book is extremely useful to students of medicine who wish to review the subject.

**A Text-Book of Embryology for Students of Medicine.** By J. C. HEISLER, M.D. (Philadelphia: W. B. Saunders, 1899.)

The work thus presented to us is an attempt to supply the real need of a concise text-book of embryology, written in the English language, and planned especially for the average medical student who is learning anatomy.

A few words will characterize the book. It is not a new account, but a condensed familiar one. It is a fairly straightforward statement of human development, such as one might write who was acquainted with anatomy, and who wrote the embryological story from a reliable knowledge of four or five well-known text-books; as, for instance, Mark's translation of Hertwig's work (the influence of which is very strongly manifest); the American text-book of obstetrics; Minot's embryology; Piersol's histology, etc.

The press-work is good, and large-type headings are convenient for reference. Comparative references and discussions are eliminated wherever possible; making it easy to quickly find the main facts of development as here given for any special structure.

The weakest portion of the book is that devoted to the earlier phenomena: fertilization, the ovum, maturation, the sperm, cleavage, germ-layers, foetal appendages, etc.

On reading these pages (and the same is true of other sections), we wonder how the writer of a text-book to-day can be satisfied with such an antiquated and incomplete résumé. Certainly, there has been no lack of remarkable discoveries and well-founded generalizations by the embryologists and cytologists of the last ten years, from which to formulate a modern and comprehensive statement, however brief.

In all fairness to the science it attempts to treat, a good text-book

should be at least up to date, representing the most recent advances in all lines of investigation. The book before us would be greatly improved by the incorporation of what is found to be valuable, after a judicial sifting of the original contributions of recent embryological research.

We must not, however, be too severe on those who seek to adapt the good work of others to a special need—a difficult task. Even if the result be little more than a fairly clear restatement of the conceptions of two or three master minds, who have already brought together the main threads of research, those who may be introduced to the subject in this indirect manner, will, at any rate, receive many valuable and reliable facts. H. MC. E. K.

**Essentials of Anatomy, including the Anatomy of the Viscera, arranged in the form of Questions and Answers prepared especially for Students of Medicine.** By CHARLES B. NANCY, M.D., Professor of Surgery, etc., in the University of Michigan. Sixth Edition, thoroughly revised by FRED. J. BROCKWAY, M.D., Asst. Demonstrator of Anatomy, Columbia University, New York. (Philadelphia: W. B. Saunders, 1899.)

This is a thoroughly revised sixth edition of a useful little book which has been approved by long service in medical schools and training schools for nurses. It is concise without the sacrifice of clearness, and the excellent illustrations assist the text.

**The Hygiene of Transmissible Diseases; their Causation, modes of Dissemination and methods of Prevention.** By A. C. ABERT, M.D., Professor of Hygiene and Bacteriology, and Director of the Laboratory of Hygiene, University of Pennsylvania. Illustrated. (Philadelphia: W. B. Saunders, 1899.)

As the title indicates, this volume of 300 pages gives an account of transmissible diseases with details, more or less complete, as to their proper and successful management. The section on the causation of disease is probably the most satisfactory and philosophical of the whole book. It treats of the influence of age, sex, race, occupation, density of population, heredity and season, upon diseases in general; and also of chemical, physical, mechanical, parasitic and bacterial agencies as exciting causes of the actual development of diseases. This section is well illustrated by tables, charts and diagrams. The following section, on the causation, modes of dissemination and prevention of special diseases, contains much information as to diseases which are transmitted from one person to another. The account which is here given of the bacteriology of transmissible diseases is full and extremely satisfactory, as would naturally be expected from so accomplished and skillful an observer. The sections on prophylaxis and disinfection are also valuable, and the directions which they contain are sensible and practical. The book is well calculated to meet a want which has long been felt by physicians and nurses.

**The Bulletin of the Ohio Hospital for Epileptics, Vol. I, Nos. 2 and 3.** Gallipolis, O. The Hospital, 1898.

The volume consists of a number of papers by Dr. A. P. Ohlmacher, with an introductory statistical report by H. C. Rutter, manager of the hospital. The first two of Dr. Ohlmacher's papers form an account of the autopsies in cases of epilepsy performed during his service, which he prefaces with a somewhat detailed description of a rather ordinary autopsy technique. In these cases, special attention has been directed to the association of the lymphatic constitution with epilepsy, and throughout the report the effort is made to show that "idiopathic" epilepsy may perhaps be the direct result of the presence of the "constituita lymphatica." It is sometimes difficult to follow the chain of arguments which connects the lymphatic constitution with epilepsy, rhabdismus, tetany and exophthalmic goitre on the one hand and with the causation of gliomata on the other.



Two other papers are concerned with the description of various tumors of the central nervous system, with secondary epileptic symptoms. It is to be regretted that amid the profusion of illustrations there are no drawings of the microscopical appearances of the tumors to supplement the descriptions. In the fifth paper, there is described the case of an idiot child with immense thickening of the skin and subcutaneous tissues in association with atrophy of the thyroid, and another case in which there was a localized area of thickening of the skin without thyroid atrophy. Finally, the last paper is devoted to the description of tumors occurring in various animals.

The report is marked by a diffuseness which seems unfortunately common in neurological literature, but the suggestions contained are very worthy of confirmatory work. It seems especially desirable, too, that such work on comparative pathology as is embodied in the last paper should be more extensively carried out.

**A Manual of the Practice of Medicine.** By A. A. STEVENS, M. D., of Philadelphia. (*Philadelphia: W. B. Saunders, 1900.*)

This is the fifth edition of this work, which shows its popularity. Any extended notice regarding the book is unnecessary. Dr. Stevens has succeeded in condensing much into 500 small pages. The material chosen, and the method of its arrangement, make it one of the best books of its kind.

**The American Year-Book of Medicine and Surgery**, edited by GEORGE M. GOULD, M. D. Medicine. (*Philadelphia: W. B. Saunders, 1900.*)

The current volume of the Year-Book is a welcome addition to the library shelves. In these days, unaided by the *Index Medicus*, the gleaming of the fields of literature has become a heavy and often well-nigh impossible task. In this the series of volumes of the Year-Book is of valuable help. The work is too well-known to require any description of its characteristics. This yearsees a new departure in the division of the work into two volumes, which will be found most convenient. In one volume it was growing beyond the bounds of easy handling. Dr. Gould, in the preface to the volume on Medicine, notes some changes in the editorial staff. Dr. Riesman takes charge of the section on Pathology in place of Dr. Guit  ras. Drs. Wilcox and Stevens edit the department of Materia Medica and Therapeutics, while Dr. Abel is succeeded in Physiologic Chemistry by Drs. Hunt and Jones of Baltimore. The present volume sustains the previous high character of the work. Not the least useful feature is the complete index. We hope the work is having the pecuniary recognition that it deserves.

**Letter, Word and Mind-Blindness.** By JAMES HINSHELWOOD, M. D., of Glasgow. (*London: H. K. Lewis, 1900.*)

These are lectures delivered before the Glasgow Medico-Chirurgical Society which appeared in the *Lancet* and are now published in a book of 85 pages. The writer takes up the general subject of visual memory and then discusses the various groups of cases designated in the title. He is able to report several cases of his own, which were unaccompanied by derangements of the auditory and speech-motor centers. From the study of his cases and those in the literature, the writer considers that there are separate cerebral areas for the usual memory of numbers, letters and words. The lectures are well and clearly written, and the study of the cases given throws light on an exceedingly interesting subject. Dr. Hinshelwood shows how much may be made out of a few cases by thorough analysis.

## BOOKS RECEIVED.

**Archives of Neurology and Psychopathology.** Vol. II. Nos. 1-2. 1899. 8vo. 319 pages. State-Hospitals Press, Utica, N. Y.

**Transactions of the Clinical Society of London.** Volume the thirty-second. 1899. 8vo. LVII + 296 pages. Longmans, Green & Co., London.

**Transactions of the Texas State Medical Association.** Thirty-first annual session held at San Antonio, Texas, April 25-28, 1899. 8vo. 347 pages. Von Boeckman, Schutze & Company, Printers, Austin, Texas.

**A Manual of Modern Surgery, General and Operative.** By John Chalmers Da Costa, M. D. Second edition. With 386 illustrations. 1898. 8vo. 911 pages. W. B. Saunders, Philadelphia.

**A Text-Book of Materia Medica, Therapeutics and Pharmacology.** By George Frank Butler, Ph. G., M. D. Third edition, thoroughly revised. 1899. 8vo. 874 pages. W. B. Saunders, Philadelphia.

**A Text-Book of the Practice of Medicine.** By James M. Anders, M. D., Ph. D., LL. D. Third edition, revised. Illustrated. 1899. 8vo. 1292 pages. W. B. Saunders, Philadelphia.

**A Manual of the Diagnosis and Treatment of the Diseases of the Eye.** By Edward Jackson, A. M., M. D. With 178 illustrations and 2 colored plates. 1900. 12mo. 604 pages. W. B. Saunders, Philadelphia.

**A Manual of the Practice of Medicine.** Prepared especially for students. By A. A. Stevens, A. M., M. D. Fifth edition, revised and enlarged. Illustrated. 1898. 12mo. XV + 519 pages. W. B. Saunders, Philadelphia.

**A Text-Book of Diseases of Women.** By Charles B. Penrose, M. D., Ph. D. Third edition, revised. Illustrated. 1900. 8vo. 531 pages. W. B. Saunders, Philadelphia.

**Hints on Elementary Physiology.** By Florence A. Haig-Brown. With twenty-one illustrations. 16mo. 1897. XII + 121 pages. P. Blakiston, Son & Co., Philadelphia.

**The Medical Annual Synoptical Index to Remedies and Diseases.** For the twelve years, 1887 to 1898. 12mo. 411 pages. [1899.] John Wright & Co., Bristol. Simpkin, Marshall, Hamilton, Kent & Co., Ltd., London.

**Progressive Medicine.** A Quarterly Digest of Advances, Discoveries and Improvements in the Medical and Surgical Sciences. Edited by Hobart Amory Hare, M. D. Volumes I, II, III, IV. March, June, September, December, 1899. 8vo. Lea Brothers & Co. Philadelphia and New York.

**A System of Medicine.** By Many Writers. Edited by Thomas Clifford Allbutt, M. A., M. D., LL. D., F. R. C. P., F. R. S., F. L. S., F. S. A. Volumes VI, VII, VIII. 1899. 8vo. The MacMillan Company, New York.

**Transactions of the American Ophthalmological Society.** Thirty-fifth annual meeting, New London, Conn. 1899. 8vo. 469-592 pages. Published by the Society, Hartford.

**Saint Bartholomew's Hospital Reports.** Edited by Norman Moore, M. D., and D'Arcy Power, F. R. C. S. Vol. 35. 1900. 8vo. 356 and 246 pages. Smith, Elder & Co., London.

**Transactions of the Louisiana State Medical Society.** Twentieth annual session held at New Orleans, La., May 16, 17, 18, 1899. 8vo. 173 pages. New Orleans.



*Practice of Medicine.* A manual for students and practitioners. (Lea's Series of Pocket Text-Books) by George E. Malsbary, M. D. Series edited by Bern B. Gallaudet, M. D. Illustrated with forty-five engravings. 1899. 12mo. 404 pages. Lea Brothers & Co., Philadelphia and New York.

*The American Year-book of Medicine and Surgery.* Collected and arranged with critical editorial comments by S. W. Abbott, M. D., Archibald Church, M. D., et al. Under the general editorial charge of George M. Gould, M. D. Two Vols. 1900. 8vo. W. B. Saunders, Philadelphia.

*Annual and Analytical Cyclopaedia of Practical Medicine.* By Charles E. de M. Sajous, M. D., and one hundred associate editors, assisted by corresponding editors, collaborators and correspondents. Volume IV. 1899. 4to. 622 pages. The F. A. Davis Co., Philadelphia, New York, Chicago.

*Proceedings of the New York Pathological Society.* For the years 1897 and 1898. 8vo. XVIII + 289 pages. 1899. Printed for the Society.

*Seventh Report of the State Veterinarian of Maryland.* December 1, 1899. 8vo. 249 pages. Baltimore.

*Essentials of Anatomy, including Anatomy of the Viscera.* Arranged in the form of questions and answers. Prepared especially for students of medicine. (Saunders' Question-Compends, No. 3.) By Charles B. Nancrede, M. D. Sixth edition, thoroughly revised by Fred. J. Brockway, M. D. 1899. 12mo. 419 pages. W. B. Saunders, Philadelphia.

*Essentials of Medical Chemistry, Organic and Inorganic.* Containing also questions of medical physics, chemical philosophy, analytical processes, toxicology, etc. Prepared especially for students of medicine. (Saunders' Question-Compends, No. 4.) By Lawrence Wolff, M. D. Fifth edition, thoroughly revised by Smith Ely Jelliffe, M. D., Ph. D. 1899. 12mo. 222 pages. W. B. Saunders, Philadelphia.

*Essentials of Diseases of the Skin, including the Syphilodermata.* Arranged in the form of questions and answers. Prepared especially for students of medicine. (Saunders' Question-Compends, No. 11.) By Henry W. Stelwagon, M. D., Ph. D. Fourth edition, thoroughly revised. Illustrated. 1896. 12mo. 276 pages. W. B. Saunders, Philadelphia.

## MONOGRAPHS.

The following papers are reprinted from Vols. I, IV, V, VI and VIII of the Reports, for those who desire to purchase in this form:

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# BULLETIN

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## AN UNUSUAL METHOD OF PERFORMING HYSTEROMYECTOMY.

By OTTO G. RAMSAY, M. D., *Instructor in Gynecology, Johns Hopkins University, Baltimore, Md.*

An article in the Johns Hopkins Hospital BULLETIN of March, 1900, by Dr. Kelly, entitled "A Preliminary Report on the Surgical Treatment of Complicated Fibroid Tumors of the Womb, with a Description of Two New Methods," describes two unusual methods of performing hysteromyectomy in difficult cases, which reminds me of a somewhat similar operation I performed for the removal of a myomatous uterus on September 23rd, 1898.

The patient, admitted to The Johns Hopkins Hospital complaining of "tumors of the womb," was 29 years of age, and had been sick for about seven years, beginning at that time to complain of abdominal pains. The abdominal tumor was first noticed by her six years ago, and it had increased in size considerably since then.

On examination, the abdomen was found distended, especially in its lower portion, by a symmetrical tumor, which, on palpation, was found to be composed of several nodules, the largest measuring about 15 by 15 cm.

By vaginal examination, a rounded tumor was felt lying in the cul-de-sac behind the cervix and extending downward between the rectum and the vagina nearly to the vaginal outlet. The cervix could not be found by the vagina, even under ether, being displaced above the symphysis, and the tumor itself was lying quite firmly pressed against the symphysis, giving the impression that the tumor was adherent in the

cul-de-sac. This rounded tumor was connected directly with the masses felt through the abdominal wall, and on pressure through the vagina the abdominal mass could be moved slightly. It was, however, impossible to move the growth much by making pressure either through the vagina or through the rectum. (See Fig. 1.)

*Operation.*—The usual median incision was made, taking the precaution to enter the peritoneal cavity high up rather than in the usual position, so as to avoid an elevated bladder. (Kelly.) On entering the peritoneal cavity, the bladder was found displaced upward, and when the incision was lengthened, it was seen bulging out above the symphysis pubis. On examining the relations of the tumor-mass and the surrounding structures to decide in what manner it might be best attacked, it was found that it could not be delivered through the incision usually made in a hysteromyectomy, and, on further examination, the reason for this was discovered to be the extension of the growth into the cul-de-sac.

As the usual transverse operation could not be made, the next question was, by what new plan the growth might be removed. The tubes, with the broad ligaments and ovaries, were found raised up but lying somewhat anterior to the main mass of tumor, and on tracing them to their origin, the tumor was found to have arisen entirely from the fundus and posterior surface of the uterus, and the cervix and lower por-

tion of the body of the uterus could be recognized lying covered by the bladder on the anterior surface of the tumor proper. (See Fig. 2.)

In the first place, the vesical peritoneal reflection onto the uterus, which was much higher than usual, was definitely recognized and the peritoneum at this point incised, the bladder was then pushed down for a distance of 5 or 6 cm., exposing the lower portion of the body of the uterus and the cervix. When this had been accomplished, the uterine vessels on each side could be felt pulsating distinctly where they passed to the cervix. The plan of the operation which I then determined to follow was to tie the uterine vessels on both sides, then to cut across the cervix, and after that, to deliver the tumor from the cul-de-sac, thus reversing the usual steps in the operation. I first freed the ovaries from the tumor by a series of ligatures near the uterine cornu, as it was my intention not to remove them; this was easily accomplished, as their relations were not much distorted from the normal. The uterine arteries were tied just at the point where they curve up to reach the cervix. Then, as previously determined, the uterus was cut across from side to side, thus loosening the tumor entirely from its cervical and broad ligament attachments. The tumor was then fixed in the abdominal cavity only by its extension into the cul-de-sac; on attempting to raise it from this position, it was found densely adherent to the whole cul-de-sac and to the rectum posteriorly. These adhesions were carefully separated by raising the tumor slowly and dividing them with the finger as they came into view. The densest adhesions were found between the rectum and the tumor, and here some difficulty was experienced in the detachment, though a slow removal prevented any injury to the rectal coats. After removal of the tumor the remainder of the operation was carried out in the usual manner, the amputated cervix was closed in with catgut sutures, and the bare area on the floor of the pelvis cov-

ered by drawing the anterior and the posterior layers of the peritoneum together with catgut sutures. The large over-distended bladder was left puckered over the cervix, and the wound appeared as usual after a normal hysteromyectomy. Several oozing points on the rectum were checked by fine catgut sutures, the peritoneal cavity was cleansed and the abdominal incision closed in the usual manner.

The convalescence was normal, save for a slight collection of blood above the stump of the cervix between it and the bladder, which was easily evacuated by dilating the cervical canal, otherwise the patient recovered in a perfectly satisfactory manner.

#### REMARKS.

The chief points of interest in this case are the peculiar developments of the myomatous tumor from the posterior surface of the uterus and its extension into the cul-de-sac; the upward displacement of the bladder covering the whole anterior surface of the uterus, and the method of attacking such a tumor.

Such a growth is rarely seen, and, therefore, this method of operation will only be useful in a certain number of abnormal cases. The principle, however, would seem to me to be a good one, and it might also be applicable in other conditions besides cases of posterior myomatous development. Thus, for instance, in densely adherent pelvic structures, or in cases with large pelvic abscesses, it would be easier to separate the bladder from the uterus anteriorly where there are usually but few adhesions, and to tie the uterine arteries on each side before any attempt is made to remove the adherent masses, thus obviating one of the chief difficulties in such an operation, namely, hemorrhage from the misplaced or with difficulty accessible uterine artery.

The cervix, in these cases, could be cut across after tying the vessels, and a point of leverage obtained to remove more easily the adherent structures.

## A SQUAMOUS-CELLED CARCINOMATOUS DEGENERATION OF AN OVARIAN DERMOID CYST; ALSO AN ADENOCARCINOMA OF THE OVARY, ASSOCIATED WITH AN OVARIAN DERMOID CYST.

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Out of 7,600 patients admitted to the wards of the Gynecological Department of the Johns Hopkins Hospital since September, 1889, (there being 42 cases of dermoid cysts among that number), only two cases of carcinoma associated with a dermoid cyst have been observed. There was one case of dermoid cyst of the ovary coexisting with squamous-celled carcinoma of the cervix uteri, the latter extending out into the broad ligaments and to the tubes, not, however, involving the dermoid cyst. The combination of carcinoma and dermoid in the same tumor in any manner is rare, and carcinoma developed primarily from epithelial structures in a dermoid is very seldom seen.

In discussing the relations of carcinoma to dermoid cysts it is necessary to bear in mind the various possibilities, which are: First, a carcinomatous degeneration of the dermoid tumor itself; second, the carcinomatous degeneration of a part of an ovary, another part of which contains a dermoid cyst; third, the original association of a multilocular cyst with a dermoid cyst, followed by a carcinomatous degeneration of the multilocular tumor, (Gessner), and fourth, the possibility of a dermoid cyst of the ovary being invaded by a carcinoma from some contiguous organ.

The first case to be described in this report is one of carcinomatous degeneration of an ovarian dermoid cyst. Dr. Kelly



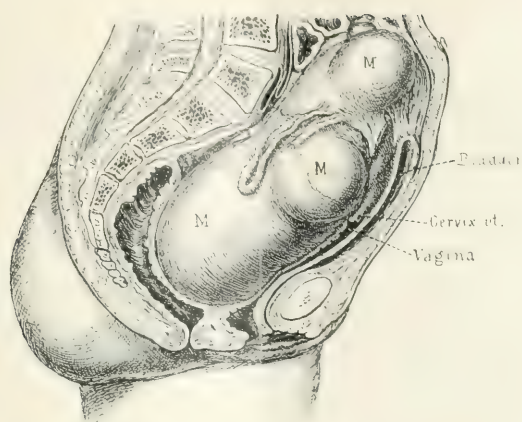


FIG. 1.—Shows the relations of the tumor to the rectum, bladder, and symphysis pubis and its extension into the endometrium.

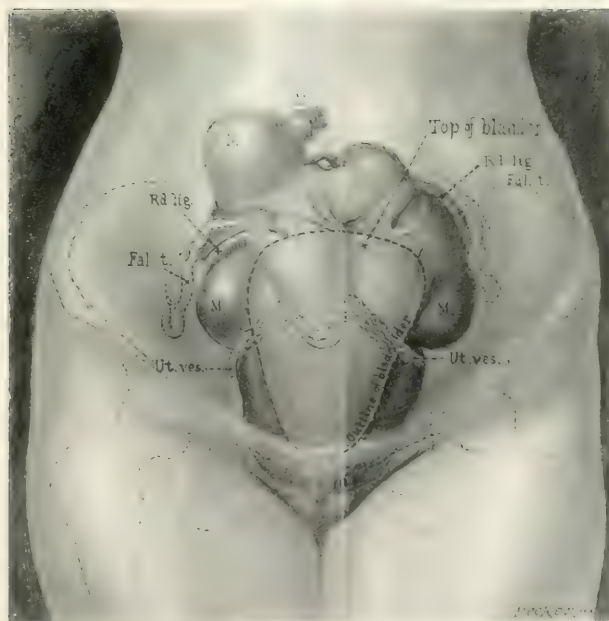


FIG. 2.—Tumor as it would appear through the transparent abdominal wall, showing diagrammatically its relations to the surrounding structures. The relations of the bladder to the cervix and body of the uterus can be well seen.



has already reported this case briefly before the Medical Society of the Johns Hopkins Hospital,\* and I shall, therefore, not dwell upon the points which he has brought out, but shall endeavor to add to what he has reported something of the subsequent history of the case, and a more detailed description of the pathological findings. I am indebted to Dr. Kelly for placing the case in my hands for thorough description and publication.

CASE I. (*Gynecological No. 7394*).—Mrs. H. T., white, aged 46 years, was admitted to the Johns Hopkins Hospital, Nov. 24, 1899. Complaint, "pain in bowels."

The patient has had 10 children, no miscarriages. There is nothing of interest in the history of her labors except that she had puerperal septicæmia after the birth of her 9th child, 14 years ago, and that the birth of her last child, 10 years ago, was induced at the 8th month on account of hæmorrhages which began in the 6th month of gestation and ceased soon after delivery.

Menstruation has always been regular and normal. The last menstruation before operation was on Nov. 4, 1899.

She has had slight leucorrhœa, from time to time, for many years.

Her family history is good, excepting that her mother died of heart disease.

Her past history is good.

The history of her present illness is as follows. Since the birth of her 9th child, 14 years ago, she has suffered with soreness in both inguinal regions, and with distressing bladder symptoms—a sensation of weight or pressure on the bladder and, at times, incontinence of urine, at other times prolonged and painful retention of urine. Seven or eight years ago she noticed for the first time a tumor low down in the left side of the abdomen. This was freely movable and changed its position whenever the patient assumed certain postures. She thinks that the tumor remained the same size from the time she first noticed it until about three months ago, when it seemed to rise and cause "knots" or "lumps" in the abdomen. About this same time (three months ago), having previously been able to go about and attend to her duties, she took to her bed on account of the severity of the bladder symptoms mentioned above, and has remained in bed ever since. For the past two weeks she has been unable to void urine, except a very little at a time, and that only while standing.

*Physical examination on admission.*—The patient is emaciated; her cheeks are sunken, the complexion is sallow, the eyes watery, the mucous membranes pale, the tongue clean.

The pulse is regular in force and rhythm, of fair volume, but rather low tension, 96 per minute. The vessel-wall is palpable.

The lungs are negative.

The heart is also negative.

*Vaginal examination.*—The external genitalia are normally developed, but somewhat atrophic. The vaginal outlet is markedly relaxed. The posterior vaginal wall presents at the vulval orifice over an area of about one square inch. The cervix cannot be distinctly outlined, but is apparently pushed upward an inch or two above the upper border of the symphysis, and to the right side. Here a small polyp can be felt. Filling the whole of the pelvis and extending to within 1½ in. of the vulval orifice, pushing forward the posterior vaginal wall, is a tumor mass. This is in places hard and firm, in other places fluctuant. It is apparently firmly fixed in the pelvis, especially on the right side. The rectum is pushed well to the left side of the pelvis and its lumen is encroached upon by the mass. The uterus is apparently situated upon the anterior face of the tumor, its fundus being about 10 to 12 cm. above the upper border of the symphysis. The

bladder is greatly distended, extending to the top of this mass which we consider to be the uterus. During examination urine passes freely from the meatus. The tumor, which apparently springs from the right side of the pelvis, extends to the umbilicus above. It is irregular in outline, somewhat nodular. It is fluctuant and tense over most of its surface and is apparently firmly fixed in the pelvis. Slight crepitation can be felt over the left anterior surface of the tumor.

*Operation (Cystectomy by Dr. Kelly).*—A median incision, 18 cm. long, was made, exposing the uterus flattened against the anterior abdominal wall. Several small, hard nodules in the bladder peritoneum were excised, and others were seen over the peritoneal surface. The tumor was densely adherent to the sigmoid, rectum and pelvic walls. A large leash of blood-vessels running in the infundibulo-pelvic ligament on the left were ligated and cut. The tumor contents (dermoid) were drawn off by a large trocar. The peritoneal coat of the tumor was incised and the tumor-wall separated, by blunt dissection along the surface of cleavage, from its adhesions to the intestines, pelvis, etc. There was moderate oozing until, on detaching the tumor from the rectum and vagina, low down on the posterior wall of the pelvis, near the anus, a carcinomatous mass was encountered, which bled freely and was curetted away. After curettage, removing about 12 cc. of friable material, resembling an advanced cervical cancer, an opening into the posterior vaginal vault was made with the end of blunt forceps and stretched the full width of the vagina for drainage. Washed-out iodoform gauze was laid in the pelvis and brought out into the vagina. The question then was, how to protect this cancerous area, sure to break down immediately, from the peritoneal cavity above. This was done by taking the large, somewhat plastic uterine body, with its right tube and ovary amputated, but with the left tube and ovary intact, and drawing it back into retroflexion, when it snugly and exactly filled the opening at the pelvic brim. The uterus was then sewed to the brim of the pelvis by continuous catgut suture, beginning with the right round ligament and suturing it for about 2 cm. to the brim and then continuing on around the fundus on a line between the tubal ends, anterior to the amputated surface on the right, over to the opposite tube and ovary and beneath them, leaving them projecting up into the abdominal cavity. The rectum was protected from sutures by a thick fold of membrane left from the capsule of the tumor. After extirpation, the rectum just had snug room at the brim of the pelvis. The left round ligament was not sutured, as the suturing ended with the infundibulo-pelvic ligament. Several bleeding points on the sac-wall were ligated. The abdomen was flushed out with normal salt solution and closed with interrupted silk-worm-gut and catgut sutures.

DESCRIPTION OF THE TUMOR.—*Gynecological-pathological No. 3647.*

*Gross description.*—The specimen consists of a cyst, a Fallopian tube and numerous small scraps of tissue of irregular shapes, which were removed by curettage from the posterior wall of the pelvis.

The cyst is 13 cm. in diameter. Exteriously it is pinkish-yellow in color and for the most part smooth, though in places, especially towards the base, dense adhesions are seen. Also near the base, on the right, postero-inferior portion of the outer surface, is a circular, rough excrescence, about 5 cm. in diameter and raised about 5 to 7 mm. above the surrounding surface. This is composed of pale-pink, somewhat hard, coarsely granular tissue, some parts of which are quite friable, other parts firmly held together by a stout fibrous

\* Philadelphia Med. Journ., 1899, Vol. IV, No. 36, p. 1208.



network. At about the centre of this circular area there is a small opening, 5 mm. in diameter, into the cyst-cavity, apparently made by tearing of the cyst-wall in removal of the tumor. There is another small opening, about 2.5 cm. long, in the upper wall of the cyst, made during the operation for the purpose of evacuating the contained fluid. The thickness of the wall varies from 1 to 4 mm., except in one part of the cyst near its base, where long, high, narrow ridges of tissue, to which wisps of long, fine, blonde hair are attached, project into the cyst-cavity. The thickness of these ridges from side to side varies from .5 to 1 cm. They rise from 1 to 2.5 cm. above the surrounding surface and are from 2 to 4 cm. long. The wisps of hair are matted together by a large amount of greasy, sebaceous secretion. In the wall, beneath the base of the highest of the ridges of tissue just described, there is found a mass of hard bone, about 2 cm. in its greatest diameter, of very irregular shape. There are also, on various parts of the inner surface, smooth, slightly elevated ridges which represent the remains of previously existing septa. The remainder of the inner surface has a puckered or rugous appearance and, in general, is of an opaque, yellowish-white color. But there are numerous areas from 3 mm. to 2 cm. in diameter which are very slightly (scarcely .5 mm.) elevated, of a reddish-brown color and have sharply defined, circular or irregular outlines. They have a somewhat velvety appearance owing to numerous minute, columnar and papilla-like projections of which they are composed. The inner surface of the cyst opposite the rough, circular area on the outer surface is comparatively smooth, except immediately around the small opening at the centre of the rough area, where there is a border about 2 to 3 mm. in diameter, composed of slightly raised, coarsely granular tissue.

The Fallopian tube is 5.5 cm. long, having a practically uniform diameter of 6 mm. It is enveloped by dense adhesions. The fimbriae are matted together, the ostium abdominale occluded. Just below the tube, between the layers of the broad ligament, 1 cm. from its outer extremity, are three small, thin-walled, translucent cysts, side by side, 3 to 5 mm. in diameter.

The irregular pieces of tissue removed by curettage are firm in consistency, dark red in color, for the most part very friable, and have many slender projections on their surfaces. They vary from 1 to 2.5 cm. in greatest diameter.

With the exception of the scraps of tissue removed by curettage from the posterior wall of the pelvis, which were preserved in a 5 per cent solution of formalin, the gross specimen was preserved in Müller's fluid and afterwards washed in running water, then placed in 95 per cent alcohol. Sections were cut for microscopic study from (a) the ridges of tissue from which the wisps of hair took origin; (b) various parts of the wall, not including the rough excrescence on the outer surface; (c) the portion of the wall occupied by the rough excrescence; (d) from the scraps of tissue curetted from the posterior wall of the pelvis; (e) from the Fallopian tube. These, after being properly hardened by the usual method, were embedded in celloidin. Microtome sections were then cut and were stained with hæmatoxylin and eosin.

*Microscopic description.* (a). Sections through the ridges

of tissue from which the wisps of hair took origin are seen to have very uneven surfaces, presenting alternate, irregular projections and depressions. Upon the surface is a layer of stratified squamous epithelial cells, which varies from 2 or 3 to 6 or 7 cells in thickness. The most superficial of these epithelial cells have degenerated and have been cast off from the surface either singly or in homogeneous, deeply eosin-stained bands formed by the coalescence of the superficial cells. Definite prickles are seen in the deepest stratum of the layer. In many places the epithelium covering the surface is degenerated throughout the thickness of the layer, being converted into a mass of refractile, disintegrated, deeply eosin-stained tissue. In the stroma beneath the layer of surface epithelium there are many cross and oblique sections of hair follicles and numerous normal sebaceous and sudoriparous glands. Some of the hair follicles contain hairs, others do not. The stroma is composed of dense, wavy fibrous tissue, poor in nuclei, and running through it are many thin-walled blood-vessels. There are also many masses of colored blood-corpuscles in the stroma, some of which are free in the tissues, others contained in the walls of congested blood-vessels. The tissues, in many places, show beginning hyaline change. Scattered through all the tissues of the wall are fairly numerous small round cells and a few polymorphonuclear leucocytes. The degree of the leucocytic invasion varies very much in different parts of the specimens, being quite dense in many places near the inner surface.

(b). On examining many sections from various parts of the wall (not including the rough excrescence on the outer surface), it is found to be composed for the most part of dense fibrous tissue which, in many places, shows hyaline degeneration. In a few places, small bundles of non-striated muscle-fibres are seen. The fibrous tissue is densest next to the outer surface, where, in some places, its appearance is suggestive of ovarian stroma. The outer surface is generally smooth and even, but here and there thick, non-vascular tags of adhesions are seen. There are also a few slit-like spaces just beneath the outer surface lined by a single layer of flattened, endothelial cells. Blood-vessels of considerable size are scattered in moderate abundance through all parts of the wall.

The inner surface is, for the most part, devoid of any epithelial lining, although in some places it is covered by layers of stratified epithelium from 2 or 3 to 15 or 20 cells in thickness. The cells in the thickest layers are, in general, flattened from side to side instead of from above downward, as in the stratified squamous epithelium of normal structures such as the cervix uteri, vagina, skin, etc. In the thinnest layers they are flattened from above downward, and in the layers intermediate in thickness they are much less compressed, *i. e.*, more polyhedral in form. Some of the cells in the deepest strata are prickles. No definite papillae are formed beneath the epithelium. The portions of the inner surface not covered by epithelium are wavy in outline and composed of fibrous tissue, which, in many places, resembles chronic granulation-tissue, containing many very small, well-formed, congested blood-vessels. The tissues, a short distance below the surface, are permeated by extravasated blood.

The reddish-brown, slightly elevated areas on the inner

surface, noted in the macroscopic description, are seen in the microscopic specimens to have very uneven surfaces, presenting many irregular depressions and processes. They are composed of loosely disposed cells, which are exceedingly multifarious in size and structure. Some of the cells are of moderate size, polyhedral in shape, containing single, spherical or oval nuclei, which stain homogeneously. There are a few elongate cells with spindle-shaped nuclei, but the most conspicuous feature in the tissues of these areas is the presence of immense giant-cells, some of which occur in groups of from 2 to 5, and appear to be partly fused with one another. They are seen sometimes on the surface, sometimes a short distance below it. Each giant-cell contains from 3 or 4 to 40 or 50 small spherical nuclei, which are grouped around the periphery in some of the cells, towards the centre in others. Numerous minute blood-vessels, many of them engorged with blood, run in and out among the cells, and in the interstices of the tissue are large numbers of small round cells, polymorphonuclear leucocytes and colored blood-corpuscles. The protoplasm of the cells containing single nuclei, as well as that of the giant-cells, is deeply stained with eosin, and has an homogeneous, cloudy, blurred appearance, the outlines of the cells being as a rule ill-defined. The deepest portion of this tissue is continuous with underlying hæmorrhagic areas in the cyst-wall. Its cells show no evidence of abnormally active proliferation, nor any tendency to strike downward into the subjacent tissues.

(c). Sections through the part of the wall occupied by the circular excrescence on the right, postero-inferior portion of the outer surface have the following appearances:

The distance from the inner to the outer surface in the sections varies from .5 to 1 cm. The outer portions of the wall are composed mostly of masses of epithelial cells. These masses are very irregular in shape, of various sizes, and are separated from one another by dense fibrous stroma. The epithelial cells in the masses are very variable in form and size, the average-sized cells being about as large as the cells seen in the stratum granulosum of the skin. In general, the cells on and near the margins of the masses are smaller, more closely packed together, and contain more deeply stained nuclei than the cells nearer the centres of the masses. The cells near the central portions of the masses are very large and their nuclei are somewhat more palely stained than those near the margins. All of the nuclei vary greatly in intensity of staining. They also, like their containing cells, are very variable in size, some of them being as much as 5 or 6 times larger than the average-sized nucleus. They are, as a rule, spherical or ovoid in shape, consisting of an outer, narrow, homogeneous, pellucid, lightly hæmatoxylin-stained rim or capsule and a large, central mass of coarse, highly refractile, deeply hæmatoxylin-stained granules, in a few of them a central, spherical or ovoid nucleolus being seen. The protoplasm of the cells is finely granular and stains deeply with eosin. In some places, where the outlines of the cells are distinctly seen, prickles are observed around the margins of the cells. There are many large, necrotic areas in which no cellular elements are

found. Small areas of necrosis are often seen in the central portions of the epithelial masses.

The masses of epithelial cells just described have the arrangement and other characteristics of carcinoma; they are, in fact, "carcinoma cell-nests." The new growth, although involving chiefly the outer layers of the cyst-wall, is found (in sections through the wall made in such a way as to include the rough margins of the small opening on the inner surface, opposite the centre of the circular excrescence on the outer surface) to extend through the entire thickness of the wall, in one place a transition from the lining epithelium into the carcinomatous tissue being seen. The only carcinomatous portion of the inner surface is that covered by the rough margins of the small opening opposite the centre of the excrescence on the outer surface. The carcinomatous tissue is seen undermining the lining epithelium as well as growing downward from the inner surface. The growth spreads more and more laterally as it approaches the outer surface.

The portions of the sections not invaded by the carcinoma are composed of dense fibrous tissue. All of the tissues are diffusely infiltrated with leucocytes—chiefly polymorphonuclear. The infiltration is most marked in the fibrous stroma around the cell-nests.

In these sections no karyokinetic figures are found. There are, however, a considerable number of tumor-cells, in each of which a pair of nuclei is seen. Each nucleus in every pair has the form of one-half of an ovoid which has been divided at a right angle to its long axis, the divided ends facing each other and being almost, if not quite, in contact. Except for their form and their position relative to each other, these twin nuclei do not differ in appearance from the nuclei of the tumor-cells in general, nor is any difference between the appearance of the protoplasm of the cells containing the twin nuclei and that of the cells containing single nuclei detected. In addition to the twin nuclei, one occasionally sees a nucleus with a faint, indefinite, light line running across its middle. Some cells are found in which there are three distinct, well-formed nuclei, which are closely adjacent to one another, their adjacent edges being flattened as if from pressure against one another, and a few cells are seen in which there are indistinct lines of cleavage (?) in each nucleus, dividing it into four parts. Still another type of cell is seen which is always mononuclear and is noteworthy, not on account of any peculiarity of its nucleus, but because there are light lines radiating from the margins of the nucleus through the protoplasm to the borders of the cell-wall. These cells are always nearly exactly circular in outline, and their protoplasm stains deeply with eosin in a narrow zone immediately around the nucleus, from which the color gradually shades into a very pale pink at the margins of the cell.

Occasionally one finds a group of cells arranged in concentric layers around a central cell, all the cells in the layers being flattened towards the centre of the group. They have the appearance of "carcinoma pearls" in an early stage of formation.

(d). In the sections from the scraps of tissue curetted



away from the posterior wall of the pelvis, the same tissue-elements are found as were described for the outer part of the wall in the third group of sections (c), and the tissues have the same general arrangement into epithelial masses surrounded by dense fibrous stroma. The epithelial cells, however, differ from those described under group (c) in the following respects: the former have a smaller average size than the latter, their protoplasm stains a faint pinkish-violet color instead of taking an intense eosin stain and their nuclei, instead of being composed of coarse granules are vesicular, having very thin walls containing fine, loosely scattered granules of chromatin. Many of the cells in these sections contain karyokinetic figures showing various stages of indirect cell-division, some of the figures being symmetrical, others asymmetrical. Also many cells are found containing 2 or sometimes 3 well-formed nuclei within a single cell-wall which shows no evidence of beginning division. All of the tissues are diffusely infiltrated with polymorphonuclear leucocytes and small round cells, the infiltration being most marked in the fibrous trabeculae between the epithelial masses. There is no suggestion of a glandular arrangement of the cells.

(e). The folds of the mucosa of the tube are normal in size and are not adherent to one another. They are covered by a single layer of normal, low-columnar, ciliated epithelial cells, which contain spherical or oval, evenly stained nuclei. The stroma of the folds has the normal appearance and is free from leucocytic infiltration. The muscular coats are atrophied, appearing in small, scattered strands of non-striated muscle-fibres just exterior to the tubal mucosa. Between the scattered strands of muscle-fibres is dense, wavy, fibrous tissue, poor in nuclei. The outline of the outer surface is generally slightly wavy and is partly covered by small cells, in a single layer, which have large, oval nuclei, flattened from above downward, which almost completely fill the cells. These are endothelial cells of the peritoneum. There are a few tags of old, slightly vascular, fibrous adhesions projecting from the outer surface.

DEDUCTIONS FROM DESCRIPTION OF SPECIMEN.—From the above description it is evident that we are dealing with a squamous-celled carcinomatous growth in the wall of a dermoid cyst. As a transition from the lining epithelium of the cyst into the carcinoma is demonstrable in the microscopic specimens and, moreover, there being no discoverable carcinoma in any other part of the body, there can be no doubt that the origin of the growth was from the lining epithelium of the cyst. The fact that the growth at its point of origin covers such a small area and projects so slightly into the cavity of the cyst is remarkable, and we offer as an explanation thereof the suggestion that the pressure exerted by the contents of the tensely distended cyst may have prevented the growth of the tumor into the cavity.

Concerning the peculiar appearances in some of the tumor-cells noted in the description of group (c) of the microscopic specimens, it is impossible to arrive at any conclusions, the tumor not having been placed in the fixing fluid until several hours after its removal from the body. However, we think it possible that the appearances are due to changes in the cells which have taken place after extirpation of the tumor, the

nuclei in groups of 2, 3 and 4 being possibly the result of the completion of the cycle of division by nuclei which, at the time of removal of the tumor, had already begun to divide. The appearance of some of the multinuclear cells is, however, very suggestive of direct division of the nuclei.

The giant cells noted in the description of group (b) of the microscopic specimens have the same appearance as the giant cells which are often met with on the inner surfaces of dermoid cysts free from any malignant new growth. These have been described (Hildebrandt<sup>1</sup>) as foreign-body giant-cells, supposed to be due to the presence of hairs in the walls of the cysts; but we have often observed them in parts of the walls of dermoid cysts in which there were no hairs to be seen and also in simple dermoids in which no hairs were found in any part either by macroscopic or microscopic examination; they are, therefore, as suggested by Cullen, more probably a form of embryonic epithelium from which the lining epithelium of the cysts is developed. In the case which we now have under consideration the giant-cells are found in parts of the tumor remote from the ridges of tissue to which alone the hairs were attached.\* The tissue in which some of our giant cells are embedded is, in all probability, granulation tissue formed as a result of long-standing inflammation of and hæmorrhage into the tissues upon and immediately beneath the surface of the cyst-wall.

POST-OPERATIVE HISTORY.—The patient had practically no nausea after operation, but pain during the first 3 days was sufficiently severe to require morphia. During the 5th, 6th and 7th days the gauze drain in the pelvic cavity was gradually pulled out, a small piece of it being clipped off each day, until on the 8th day all that remained of the drain was removed, after which a considerable amount of sanguino-purulent fluid escaped. The cavity in the pelvis was then carefully cleansed by douching with a saturated solution of boracic acid and again filled with clean gauze. From this time on dilatation of the opening into the cavity and douching and repacking of the cavity were repeated every day. On the 9th day the abdominal wound was inspected and found to have healed perfectly. Alternate silkworm-gut sutures were removed. On the 12th day all remaining sutures were removed from the abdominal incision, and the following note was made. "By examination with one finger in the cavity and another finger in the rectum, it is ascertained that the cavity lies entirely to the right of the rectum and is separated from it by a septum of firm, indurated tissue, about .5 cm. thick, which extends upward (along the side of the rectum) to a point just within the reach of the examining finger. The lumen of the rectum is considerably encroached upon."

The patient was allowed to be out of bed in a wheel-chair on the 24th day, and was able to walk several days before her discharge from the hospital on the 36th day.

During the entire convalescence there was considerable

\* Cullen says that in very early dermoids of the ovary, where no epithelium is as yet present and where no sebaceous nor sudoriparous glands are found, the diagnosis can be made, with almost absolute certainty, from these characteristic giant cells. (*Personal communication*).



sanguino-purulent discharge, which at times had an offensive odor. The patient complained repeatedly of pain in the right hip and back, chiefly at night. There was also, at times, severe pain in the rectum, which was, however, relieved by defecation.

During the first 3 days after operation the temperature chart showed a range of temperature between 100° and 101°F., the pulse ranging between 96 and 108 per minute. After this time the temperature continued very slightly above normal until the end of convalescence, except on the 19th and 24th days, when there were slight rises to 100.5°F. The pulse, after the 3rd day, ranged between 88 and 104 per minute.

The following is a note made on the discharge of the patient from the hospital on the 36th day. "The cavity posterior to the vagina has decreased in size. It holds about two ounces. The new growth has increased markedly and extends down to the anal orifice. The opening into the cavity admits the index finger. The uterus is felt in adherent retroflexion. The patient's general condition is only fair; she suffers considerable pain in the hip and back; she also requires codeia at night for sleep, and suffers with constipation."

In a letter written thirteen weeks after operation, the patient states that she notices very little change in her general health since leaving the hospital, but that she now has a very offensive discharge, "like decayed blood," from the rectum. It is, therefore, highly probable that the carcinoma has now extended through the rectal wall. The fact that the patient is still alive and notices very little change in her condition, except that which can be explained by local extension of the growth, shows that the efforts to protect the abdominal cavity by suturing the uterus to the pelvic brim have been successful.

REVIEW OF THE LITERATURE.—The first indubitable case of carcinoma developed from epithelial elements of a dermoid cyst is that reported by Bierman,<sup>2</sup> in 1885. Before that time other cases had been published by Heschl,<sup>3</sup> von Wahl,<sup>4</sup> Cohn,<sup>5</sup> Veit<sup>6</sup> and Pomorski,<sup>7</sup> in which carcinoma and dermoid cysts were said to be associated in the same tumor; but none of these will be discussed, some of them being too inadequately reported to establish their authenticity, others undoubtedly deserving to be considered as "mixed tumors" and not as dermoid cysts which have undergone carcinomatous degeneration. In 1884, Babinski<sup>8</sup> reported two cases which he considered to be carcinoma "probably" derived from dermoid cysts, but his descriptions are meagre and his conclusions are uncertain. After the publication of Bierman's case, Himmelfarb,<sup>9</sup> in 1886, Krukenberg,<sup>10</sup> in 1887, and Tauffer,<sup>11</sup> in 1895, each reported an authentic case of squamous-celled carcinomatous degeneration of a dermoid cyst. In 1897, two other cases were published, one by Thumin,<sup>12</sup> another by Yamagiwa.<sup>13</sup> Clark,<sup>14</sup> while working in the laboratory of Chiari, at Prag, published, in 1898, the case of a dermoid cyst which had been discovered among a large collection of museum specimens and which proved, on microscopical examination, to have undergone carcinomatous change in one part. The tumor had been extirpated by abdominal section, in May, 1885, from a woman aged 29 years. At the same operation a metastatic nodule the size of a walnut was removed from the left axilla.

The patient made a good recovery from the operation, but no further history was obtainable. Clark was able to trace, in the microscopic specimens, a transition from the normal epithelial lining of the cyst into the carcinomatous tissue. He also described giant-cells similar to those which we have noted in our case. Tauffer gives very full abstracts from the descriptions of the cases of von Wahl, Heschl, Bierman, Himmelfarb and Krukenberg, and Clark also gives a very satisfactory summary of all the cases published prior to his own.

Since the report of Clark's case, we find only one other observation of carcinomatous degeneration of a dermoid cyst of the ovary, that reported by Lockhart and Anderson,<sup>15</sup> in 1899. In their case the patient was an unmarried woman, 50 years of age. At operation, the tumor was punctured and "120 ounces of thick, grumous fluid, containing caseous material and hair," escaped, revealing the dermoid nature of the tumor. It was learned that the tumor had originated in the left ovary, and that its pedicle, consisting of the uterus and broad ligament, was twisted half way around. Many dense adhesions of the cyst to the upper part of the left wall of the abdomen, to the omentum, to the under surface of the right lobe of the liver, to the right anterior abdominal wall and to the intestines, were encountered. The patient did well for the first four weeks after operation, and was discharged from the hospital on the 31st day, but died one week later. The tumor is described as a "large, irregular-shaped mass, measuring 18 x 15 x 14 cm., weighing 1,570 grms." Its peritoneal covering was "thickened and hæmorrhagic." On section it was found to be composed of a "series of large cysts whose walls were markedly thickened, in some places measuring 5 cm." The cyst contained a "thick, oily, flocculent fluid, as well as two large, rounded masses of hair, about the size of large apples." Three teeth, embedded in the wall and projecting into the cyst-cavity, were also found. The following is a copy, in full, of the description of the microscopic specimens: "The tumor is seen to be composed mainly of epithelial elements, which infiltrate extensively the fibrous tissue stroma. Multiple pearl-nests are found in these areas. At other points the epithelial cells are arranged in alveolar and tubular forms, as in carcinoma, with large bands of fibrous tissue surrounding them. A large amount of adipose tissue is also present. The vessels throughout are numerous, and engorged with blood, and in places surrounding these are a large number of small, round cells." They then conclude:

"The tumor is, therefore, an ovarian dermoid cyst, with epitheliomatous, and, in some places, carcinomatous infiltrations. It also shows evidences of acute, and, in some places, sub-acute inflammatory reaction."

Cone,<sup>16</sup> in 1897, described a dermoid of the lower jaw which showed squamous-celled carcinomatous degeneration, and referred to similar cases observed by Franke, Czerny and Briddon. Cone also noted in his case the presence of giant-cells. These were of two kinds, one of which were found around the roots of hairs and thought to be "foreign-body giant-cells," the other kind being seen in the centres of typical tubercles and considered as "tubercle giant-cells."

In 1897, Yamagiwa published, with his case, which we have

already alluded to, another case which he believed to be one of adenocarcinoma, developed from a nipple-like growth or anomalous, misplaced mammary gland on the inner surface of the dermoid cyst. That is the only case of adenocarcinomatous degeneration of a dermoid of which we are able to obtain record.

As yet, no case of carcinoma, thought to be derived from the sudoriparous or sebaceous glands of a dermoid cyst, has been reported.

The secondary changes, other than carcinomatous, which have been observed in dermoid cysts, are rather limited in variety. Friedländer<sup>7</sup> has reported an instance of cystic degeneration of glands in the wall of a dermoid, Bierman<sup>18</sup> an instance of primary sarcoma and Faquet<sup>19</sup> an instance of endothelioma in a dermoid. Papillary growths in multilocular ovarian cysts, which were only partly dermoid, have also been reported.

The remaining case which we have to report is interesting as an example of the second class of possibilities which we have mentioned, *i. e.*, a carcinomatous degeneration of a part of an ovary, another part of which contains a dermoid cyst. On looking through the literature we do not find any similar case previously reported.

CASE II. (*Gynecological No. 5164*).—Mrs. K., white, aged 36 years, was admitted to The Johns Hopkins Hospital, April 6, 1897.

The patient has had 6 children and 1 miscarriage. Puerperal fever followed her last confinement, six years ago, and at the same time she had "milk leg," affecting the right lower extremity.

Her menses began at 16 years. They are always regular and last 3 to 4 days.

She had profuse and offensive leucorrhœa for two years after the birth of her last child.

Two uncles died of phthisis. The family history is otherwise negative.

The patient has had only the usual diseases of childhood, and has always been strong and well.

Her present illness began in August, 1896, with fever which her doctor pronounced typhoid. She was in bed two weeks and since then has had fever "off and on," and at recent menstrual periods has suffered exquisite pain in the left ovarian region, with great nausea and vomiting.

*Operation (Double Cystectomy, with removal of the uterus, by Dr. Kelly).*—The right ovary is found converted into a lobulated and nodular tumor about 10 cm. in diameter. This is slightly bound down by adhesions, and at its inner and upper pole is a subperitoneal cyst, 4 cm. in diameter.

Enucleation was commenced on the right side on account of adhesions of the left ovary, which was twice the normal size and was occupied by a growth similar to that on the right. The uterus was amputated at the cervix, and the operation was then completed in the usual way. Small, secondary nodules were seen in the omentum.

Over the region of the left kidney there was a lobulated, nodular mass about 8 x 7 cm. This was probably infiltrated omentum.

The abdomen was washed out with salt solution. In closing the wound, catgut was used for the peritoneum, and interrupted, through-and-through silk-worm-gut and catgut for the other layers.

DESCRIPTION OF THE SPECIMEN. *Gynecological-pathological No. 1645.*

*Gross description.*—The uterus measures 6.5 x 4.5 cm. The posterior surface and fundus are covered by adhesions. On section the uterine cavity is seen to be 4 cm. long, and 4 cm. broad at its fundus. The uterine mucosa is pale and looks edematous. In the cervix is a dilated follicle 4 mm. in diameter.

*Right side.*—The ovarian tumor, which resembles a cystic kidney in contour, measures 10 x 5.5 x 4 cm. The surface is nodular, and on one side is a bunch of 8 or 9 cystic or partly-solid nodules, some of which resemble hemorrhagic Graafian follicles, others contain clear fluid. On section, the tumor is found to be of a yellowish color and to consist of a somewhat friable, homogeneous or fibrillated tissue, which here and there, around the periphery, presents small cystic areas into some of which hemorrhage has occurred. In the hilum of the tumor is a cyst 2.5 x 1.5 cm. which contains a buttery material resembling dermoid contents.

The Fallopian tube is bound down to the surface of the tumor, but is apparently patent.

*Left side.*—The ovary is converted into a small, nodular tumor, 4 x 3 cm., resembling the one on the opposite side. On its upper surface, at the inner pole, is a corpus luteum 1 cm. in diameter.

*Microscopic examination.*—The uterine mucosa has an intact surface epithelium. The glands are abundant and a few slightly dilated. Frequently a gland is seen extending a short distance into the muscular coat, but the glands are perfectly normal. The stroma of the mucosa is rarefied.

*Right side.*—The ovarian elements are almost entirely replaced by neoplastic tissue. This consists of narrow, branching processes of epithelium penetrating the stroma in all directions. These processes often consist of but two rows of cells, which may present a narrow central lumen. Frequently, however, the cells form solid cylinders, sometimes of considerable thickness. On cross-section, solid nests of epithelial cells are found or a minute cavity, lined by one layer of cells. The individual cells vary in size and form, but are usually large, oval or cuboidal, and contain large, round, oval, crescentic or irregular nuclei, which in general take an intense, solid stain. Nuclear figures, both symmetrical and asymmetrical, are abundant, and there is slight karyorrhexis, but, on the whole, nuclear fragmentation is not notable, and cell degeneration of all kinds is practically absent. The cell-masses are separated from one another by delicate strands of connective tissue, but the tumor is further irregularly divided into lobules by broad bands of connective tissue, and by practically unaltered ovarian stroma, which, in some portions, especially around the periphery of the tumor, is present in considerable amount, though in every part showing, here and there, small epithelial masses.

The cystic portions appear to have originated in Graafian follicles or degenerated corpora fibrosa. In one section a corpus fibrosum is found. Scattered through the stroma are a moderate number of small round cells. The vascularity of the tumor is moderate, the vessels usually of small size.

The cyst found in the hilum of the tumor presents the usual appearances of a simple dermoid. It is lined by stratified squamous epithelium, and in its wall are a few sebaceous



glands. No hair follicles are seen. For the most part the cyst is surrounded by a narrow band of connective tissue or ovarian stroma, but at some points the epithelial cells have penetrated to the surface and cell-masses are found in the mesosalpinx and even between the layers of muscle-bundles in the tube-wall. The broad ligament also contains metastases, cell-nests being found in the lymph-spaces, and, in one place, in a large vein. The tubal mucosa is normal and no tumor elements are found on the upper surface of the tube-wall.

*Left side.*—The tumor is similar to that on the opposite side. The corpus luteum observed macroscopically presents the usual features and shows commencing organization.

**DIAGNOSIS.**—Carcinoma ovarii duplex associated with a small dermoid cyst in the right ovary. Corpus luteum in the left ovary. Practically normal uterine mucosa. Perisalpingitis. Subperitoneal cysts.

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## PULMONARY TUBERCULOSIS, WITH DIFFUSE PNEUMONIC CONSOLIDATION, IN A LION.

By W. G. MACCALLUM, M. D., AND A. W. CLEMENT, V. S., *Baltimore, Md.*

While in Birmingham, Ala., in November, 1899, one of the lions belonging to the Hagenbeck menagerie, a large adult-male of the black-maned sort, which had been captured in South Africa and had been in captivity ten years, fell ill. The keeper noticed that the lion was not well and frequently refused food. On the removal of the menagerie to Baltimore it grew worse, developed a slight grunting cough, became very much thinner than normal, and, after an illness of about four weeks altogether, died.

The *autopsy* was performed the next day. The body was that of an adult male lion, said by the keeper to be about fourteen years old. The subcutaneous and omental fat were very much wasted. There was no accumulation of fluid in either peritoneal or pleural cavities, and the peritoneal surfaces at least were smooth and glistening.

For the sake of brevity, the description of the heart and abdominal viscera will be omitted, as they were apparently quite normal. The lungs appeared somewhat collapsed, and seemed to contain much less air than normal. Their pleural surfaces were not quite smooth, but had lost their gloss. There were, however, no adhesions between the layers. The left lung, which consisted of three lobes, was found to contain very little air, small portions of the upper lobe only being insufflated; the middle and lower lobes were quite solid. On cutting through the lung, the cut surface of the upper lobe presented, in general, a translucent appearance, being densely studded with small translucent nodules which projected from the surrounding surface; these hardly exceeded a pin-head in size, and never showed any central area of necrosis. The

intervening lung-substance was gray or grayish-yellow, and somewhat gelatinous and translucent. The lower lobes were more firmly and uniformly consolidated, the firmness being due to a diffuse consolidation rather than to the translucent nodules which were more sparsely scattered throughout these lobes. The cut surface was, as in the upper lobe, grayish-yellow and somewhat translucent. In the posterior portion of the lobe, there were two well-defined cavities communicating with one another by a narrow channel, and marked off from the surrounding lung by the fibrous thickening of their walls. These cavities communicated with the bronchi; their walls were fairly smooth and covered with a purulent material. Obliterated arteries crossed from side to side.

The right lung was much more voluminous than the left, the upper lobe being insufflated and containing only a few of the translucent nodules described. The lower lobes, as in the left lung, were consolidated. They were riddled with tubular cavities, which correspond with the bronchi, and which, for the most part, were filled with a yellowish purulent material.

The bronchial glands were slightly enlarged and deeply pigmented, but showed no areas of caseation.

Hardened sections of the upper lobes of the lung show the presence of small areas of consolidation here and there. These consist of rounded or oval tubercle-like masses of cells, sometimes close to the bronchi but more often in relation with the small blood-vessels. They are not entirely without a blood supply, for minute blood-vessels may be seen in their interior. They are made up for the most part of epithelioid cells, with vesicular nuclei arranged in an irregularly concentric manner,



often about several centres. There are very few lymphoid cells, but a considerable number of cells resembling polymorphonuclear leucocytes; and these, with the epithelioid cells, which are often much distorted and of bizarre form, make up the nodule. Very rarely is there any central giant-cell. These nodules are often very sharply outlined on account of the fact that they may fill an alveolus without disturbing the epithelium of the adjacent alveoli. The alveoli adjacent to the tubercles contain a gelatinous exudate consisting almost entirely of coagulated fluid and disquamated epithelial cells. There are a few polymorphonuclear leucocytes, but scarcely any fibrin; occasionally a little is shown by Weigert's fibrin stain.

Sections of the lower lobes show a great increase in the connective tissue throughout the lung, associated with the tubercle nodules, which are here much conglomerated. Giant-cells are seen in these matted tubercles, although so rare in the discrete nodules in the upper lobes. The alveoli of the intervening substance are completely obliterated by the fibrous tissue which is often much pigmented by coal-dust. In other portions of the lower lobes there are areas of gelatinous pneumonia, and also areas in which the walls of the alveoli, together with the exudate, have become completely necrotic and caseous.

The more densely consolidated portions often show definite bronchiectatic cavities, with thick fibrous walls and a content of cellular debris.

The giant-cells described above very commonly contain well-defined tubercle bacilli, as shown in sections stained by the method of Mallory. Stained by Weigert's method no other organisms can be demonstrated. Cultures from the lung were sterile, and two guinea-pigs, inoculated subcutaneously and intraperitoneally with emulsions of the lung substance, unfortunately died from intercurrent infections, so that no propagation of the organism was effected.

The demonstration of bacilli, identical in morphology with the tubercle bacilli in the giant-cells which formed the centres of nodules in the lung, morphologically like tubercles, seems conclusive enough evidence that the lesion was really tuberculosis of the lungs.

Sections of the other organs showed no tubercles and no other noticeable abnormality.

The exclusive localization of the process in the lungs is interesting in connection with the similar case reported by Straus,\* in which, although there were large caseous masses in the lungs, there were no other viscera involved.

Straus' case is the only one in the literature which is

described in detail. Tuberculosis in lions does not seem extraordinarily uncommon, however, for Jensen mentions two cases, Haughton another, and Rayer, quoting Pirrault, two others. It is well known from the work of Jensen,\* Eben,† Froehner,‡ Bollinger§ and others, that dogs and cats are more commonly subject to tuberculosis than is generally thought to be the case.

The localization of the tuberculous lesions in these more or less closely related animals is of interest in connection with this case. Dogs, as reported by these authors, most frequently suffer with pulmonary tubercloses, and tuberculosis of the serous surfaces is with them more common than in cats, in which, while pulmonary tuberculosis predominates, lesions in the digestive organs are especially frequent.

It is not within the scope of this note to review the literature on tuberculosis in animals, of which good summaries are given by Nocard|| and Leray,\*\* Rayer†† and others.

Lebert,‡‡ in writing of the tuberculosis of apes, states his opinion that they probably suffer in wild life as well as in menageries, and that they live no better in the tropical menageries than in the more northern ones. General opinion, however, seems to favor the view that confinement so lowers the resistance of wild animals, and especially those transported from tropical countries, as to predispose them to the invasion of the tubercle bacilli.

The most important result of a study of this case is apparently the evidence in favor of the view that a diffuse pneumonic consolidation can be caused by the tubercle bacillus alone. Cultures were sterile, and coverslips and sections showed no organisms except the tubercle bacilli, a condition not often found in the human lung, the seat of so extensive a change.

Whether the peculiarities of the bacilli, so much discussed of late,§§ or the differences in the tissues of the beasts, are to be given as the causes of the slight morphological differences in the tubercles in different animals, must be left undecided here.

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## THE JOHNS HOPKINS HOSPITAL BULLETIN.

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## ARSENICAL PIGMENTATION AND KERATOSIS.\*

BY LOUIS P. HAMBURGER, M. D., *Assistant in Medicine, Johns Hopkins University.*

This patient, who has been kind enough to appear before the society to-night, is a clerk, forty-two years of age. He entered the Johns Hopkins Hospital Dispensary on the first of November 1899, complaining of swelling of the feet and abdomen. The family history is negative. As a child he had measles and scarlet fever. He has used neither alcohol nor tobacco. To that which is of importance in his past history I shall refer later. His illness began about eight months ago with a "cold" and a cough. About a month thereafter his abdomen began to swell, and he noted that at the end of the day's work his legs were swollen. The cough soon disappeared but the swelling of the abdomen continued. He has had no shortness of breath, nausea, "fainting spells" nor symptoms of weakness. His bowels have been regular. He presented about the same condition when I first saw him that he exhibits now. He is a sparsely nourished man, the visible mucous membranes are of good color and present no unusual pigmentation. What immediately attracts one's attention is the condition of his skin. There is a more or less deep-brown discoloration over almost the entire body. The pigmentation as it appears over the abdomen may be taken as a type of this discoloration; differences in degree are presented by the skin in various localities. The skin in this situation is of a mottled yellowish-brown color; the mottling is due to small rounded areas of less pigmented, almost white skin, alternating with similar areas more deeply colored. Here and there are little dark, almost black, mole-like spots. The skin feels natural and is at points a little scaly. The face is slightly involved; it is freckled, the complexion is muddy. On the neck, particularly at the back and the sides, the discoloration is marked, being less punctate and more diffuse than over the abdomen. Still more diffuse is the coloring of the axillary folds; they are uniformly colored a deep-brown. The punctate arrangement is resumed over the shoulders and arms, being more marked over the posterior and internal aspects of the limbs. The discoloration is slight over the forearm and practically absent over the hands. The chest and upper part of back are slightly involved; the areolæ, however, are of a dark chocolate-brown color. The abdomen and lower half of back are markedly pigmented. The inguinal folds, buttocks and internal aspects of the thighs are strikingly dark. Toward the lower thirds of the thighs the pigmentation fades; the skin of the legs is only dotted here and there with spots of pigment; the feet are free from the discoloration.

The skin of the hands is rough and dry. Over the palms it is diffusely thickened. Here, as well as over the dorsal

surfaces and between the fingers, are numerous small and large dirty-gray warts and callosities from the size of a pin-head to that of a pea. Some of them look like ordinary warts; others are smaller and more like little fine local thickenings. There is a "wart" on the ulnar border of the right wrist. The nails look natural. Projecting from the left elbow for a distance of about a centimetre is a curious conical wart-like thickening recalling somewhat the heaped-up scales of psoriasis.

The soles present even a more remarkable appearance than the palms. Here too is a diffuse thickening but particularly along the outer border, the heel and area corresponding to the metatarsophalangeal articulations. Over these parts and extending a little way up the posterior aspect of the heels there are numerous yellowish horny excrescences of all sizes, discrete and confluent. The nails are unaffected. From the anterior surface of right shoulder there projected a yellowish-brown, lobulated round wart. It was excised, and, examined microscopically, shows the structure of a papilloma.

Below each internal malleolus is a reddened scaly patch having a diameter of about a half centimetre. They bleed from minute points on removing the scales (psoriasis).

The lungs are clear. The point of the heart's maximum impulse is in the 5th l. i. s. in the nipple line. At this point as well as in the axilla a blowing systolic murmur is heard. The pulse is regular, 62 to the minute.

The abdomen was distended, bulging a little at the flanks. In these regions the percussion note was flat, but became tympanitic on one side when lying on the opposite.

The liver dulness began at the sixth rib in the right parasternal line. Palpation of the abdomen was unsatisfactory owing to the distention. The skin over the shins pitted a little on pressure. The urine contained neither albumin nor sugar.

Under a course of purgation the complaint for which he sought treatment has been a good deal relieved. The abdomen is not so distended, the feet are not so much swollen.

The cutaneous changes had come on so gradually that the patient had paid little attention to them. The warts had been annoying and he had had some of them removed from time to time.

When I saw this combination of extensive pigmentation and keratosis, I made inquiry at once as to the use of arsenic. The patient was much surprised by the question, replying that he had been taking Fowler's solution in doses of from five to eight drops three times daily off and on for a period of ten years. During this time he suffered from a cutaneous eruption which first appeared as a patch on the antero-external aspect of the right knee. It was red, dry and scaly. Other patches of varying sizes appeared from time to time over the body. The eruption itched, bled on scratching, and resembled the "spots" now present on the ankles. Arsenic was prescribed and the skin disease was benefited. After three or four weeks he would discontinue the use of Fowler's solution, only to resume it as a rule in another fortnight; at times because of the

\* Presentation of the patient before the Johns Hopkins Hospital Medical Society, December 18, 1899.

[NOTE.—Since this paper has been in press my attention has been called to the excellent article by Dr. Hartzell on "Epithelioma as a Sequel of Psoriasis and the Probability of its Arsenical Origin," which was published in the *Am. J. of Med. Sc.* of September, 1899. Some of the ground here independently traversed is covered by his contribution.—L. P. H.]



appearance of a fresh patch of eruption, often because of a fear of its return. Just when the present cutaneous manifestations made their appearance he does not know, but he is quite sure that it was subsequent to the use of arsenic.

To recapitulate: This man, suffering from some chronic cutaneous affection (probably psoriasis), began taking arsenic in the usual doses ten years ago and has continued its use off and on ever since. He took the last dose three weeks before his first visit to the dispensary. Then he had ascites and presented the cutaneous lesions which we have just considered.

It is more than probable that there is a causal relation between the ascites and the use of the arsenic. In this patient no other etiological factor is available. Mr. Hutchinson\* has described a similar but more severe case in which paracentesis was performed on three occasions, complete recovery following only on discontinuing the drug. And in Geyer's report† on the endemic arsenicism of Reichenstein, due to the arsenical drinking water, several similar cases are quoted. However, it is not to this condition of our patient that I wish to call particular attention, but to the combination of widespread pigmentation and keratosis of the hands and feet. It is a clinical picture of prolonged arsenical medication. So characteristic is it that, in this case, the diagnosis can be made *de visu* without the assistance of the patient's statements.

It is right interesting to know how the relation between these dermatoses and the use of arsenic has been established. I shall begin with a consideration of the melanoderma.

Thomas Hunt is probably the first observer to call attention to arsenical pigmentation. In a communication on the administration of arsenic, published in 1847, he wrote: "The trunk of the patient first, and subsequently all those parts of the body which are by the dress protected from the access of light and air, become covered with a dirt-brown, dingy, unwashed appearance, which under a lens reveals a delicate desquamation of the epidermis, and is, in fact, a faint form of pityriasis."‡ He viewed this change as an effect of the drug's action.

In spite of this early account of arsenical melanoderma the condition was not generally recognized for many years thereafter. It was well known that any chronic inflammation of the skin might leave its mark in the shape of a pigmentation at the site of an old lesion. Hebra, in his well-known textbook, spoke of this fact in connection with cases of psoriasis, and particularly those treated with arsenic, recommending a reduction of the dose as soon as the pigmentation appears.§ No more definite statement regarding the relation between the arsenic and the discoloration is made. Before Hebra's book was published, Devergie had expressed the opinion that the pigmentation in such cases is in all probability due to the arsenic, and the term "*taches arsenicales*" is applied to the

discolored areas.\* But this view was not so readily accepted, and discussion continued as to what share the disease took and what rôle the arsenic played in the causation of the melanoderma. In time, however, there accumulated many dermatological observations, in which the pigment was said to appear at points unaffected by the original cutaneous disease, so that there could be no doubt as to its arsenical or inflammatory origin. Finally, when clinicians began to report numbers of cases, chiefly of chorea and accidental poisonings where discoloration of the skin followed the ingestion of the drug, arsenical pigmentation was accepted as an established fact and came to take its place in the list of arsenical dermatoses.† That list is a long one; besides the eruptions which we are now considering, it includes representatives of all the elementary cutaneous lesions from the oedematous to the pustular. In this connection it is of interest to note that a certain chronological sequence in the appearance of these eruptions can be observed. Some represent an acute intoxication, as it were; others, a chronic. At one end of the series stands the oedema which may come on after a day or two's administration; at the other end are the melanosis and keratosis. As a rule, the melanosis appears after a period of some weeks or months of arsenical medication. It matters not what preparation of the drug is used; arsenious acid, sodium arseniate, Fowler's solution—all have caused it.

The localization of the discoloration, as our patient presents it, may be taken as typical. The pigment appears in small yellowish-brown maculae, which coalescing may come to cover a large area of skin, giving to it a rather characteristic mottling. But it is not always characteristic enough to be distinguished from the bronzing of Addison's disease. Like the pigmentation of this disease, it is more intense in localities exposed to friction or where there is normally more or less pigment. In this patient you see how dark the axillary and inguinal folds and the areolæ are. Unlike the coloring of Addison's disease, the exposed parts do not tend to suffer, nor are the visible mucous membranes involved. The shade of the pigment does not help in the differentiation from "bronzed skin," for in both conditions all shades of brown may be represented. Indeed, a case of arsenical pigmentation has been reported in which the skin, from the groins to the toes, was "absolutely black."‡ When one considers that these patients may present the gastro-intestinal symptoms of arsenic poisoning, the differentiation between arsenical intoxication and Addison's disease becomes worthy of consideration. There is a case of so-called arsenical melanoderma on record which, by its subsequent course, proved to be an example of supranrenal disease.§

The error might have been avoided had the pigmentation of the mucous membranes been rightly interpreted.

In phthisis and exophthalmic goitre pigmentation of the

\* Archives of Surgery, 1895, Vol. VI, p. 389.

† Ueber die chronischen Hautveränderungen beim Arsenicismus u. Betrachtungen über d. Massenerkrankungen in Reichenstein. Arch. f. Derm. u. Syph., 1898, Bd. 43, S. 221.

‡ Further observations on the administration of arsenic. Lancet, 1847, I, p. 92.

§ Lehrb. d. Hautkrankh., 1874, 2 Aufl., S. 345.

\* Traité pratique des Maladies de la Peau, 1857, p. 137.

† For literature, see Geyer, loc. cit.

‡ Barthelemy: quoted by Rasch, Contribution à l'étude des dermatoses d'origine arsenicale, Ann. de Derm. et de Syph., 1893, t. IV, p. 160.

§ Audry, Ann. de Derm. et de Syph., 1896, t. VII, p. 1415. For "note rectificative," see tome IX, 1898, p. 538.



skin is sometimes seen. It is possible, as has been suggested, that in some of these cases the discoloration may have an arsenical origin, for in both diseases arsenic is often administered for long periods of time.

What are the minute changes in the pigmented skin? Our patient, grateful that the cause of his trouble had been discovered, volunteered to give us a bit of tissue for microscopical study. Accordingly, a small piece of skin was excised from the lumbar region.

In this specimen the epidermal cells are not hyperpigmented; the corium is the seat of the discoloration. The pigment is distributed almost exclusively about the blood-vessels. Hence, it is seen in the papillæ, but it is most abundant about the basilar layer of capillaries from which the papillary vessels arise. It presents itself in the adventitia of the vascular wall as little brown granules, which lie heaped up to form fine lines, or more frequently very dark ovoid and spindle-shaped groups of about the size of a connective-tissue cell. In many of these collections of pigment nuclei are visible, so that their cellular character is undoubted. The nature of the pigment granule itself is quite obscure. Mr. Hitzrot has kindly made some microchemical tests in the present case, with the same negative results that other observers report. The pigment failed to turn blue when treated with hydrochloric acid and potassium ferrocyanide, and remained unchanged on the addition of ammonium sulphid, or of a five per cent solution of neutral hæmatoxylin. There does not exist the analogy between arsenical pigmentation and argyria that Devergie claimed, for from these experiments it is clear that the pigment contains neither arsenic nor iron. Perhaps, as Geyer suggests, it is hæmatoidin. It is a fact that the long-continued use of arsenic is attended in some individuals by a decided decrease in the hæmoglobin and red blood-corpuscles. The metal itself in chronic poisoning is deposited not only in the liver and spleen, but also in the marrow of the bones; therefore, at the very fountainhead of blood-formation. These observations, added to the microscopical picture, the perivascular deposition, leave little doubt that it is from the disintegration of the blood that the pigment results, but the intimate mechanism of its formation and deposition is entirely unknown.

As to the treatment of arsenical pigmentation, the essential indication is clear. Withdrawal of the drug is usually followed in the course of months by a disappearance of the discoloration. In a few cases the pigmentation has been permanent.

Although melanoderma is a late lesion of arsenical intoxication, keratosis is a still later manifestation, and, in point of time, stands last in the series of arsenical skin eruptions. It is only within the last few years that its arsenical origin has been established beyond dispute. I say beyond dispute in face of the statements made less than two years ago by such eminent dermatologists as Kaposi and Neumann, to the effect that they had never demonstrated with certainty a single case of arsenical keratosis.\* After examining this patient and reviewing with me the literature, I will leave you to judge if these statements are warranted by the facts!

Many years ago Romberg wrote of a palmar and plantar

affection in association with the use of arsenic. He stated that he had seen exfoliation of the skin in these regions in individuals who had taken the drug.\* But, probably the first definite allusion to an undoubted case of arsenical keratosis is made by Erasmus Wilson, in 1868. In discussing the effect of fifteen months' use of the drug on his patient, he writes: "But the most striking evil resulting from the action of the arsenic next to the melasma is the state of chronic erythema of the palmar and plantar surfaces of the hands and feet. These surfaces are red, hot and swollen; the cuticle is dry, harsh, desquamating and covered with hard, dry points, corresponding with the apertures of the sweat-glands, which resemble minute corns, and which she designates by that name."†

In a report of the terrible epidemic at Hyeres, in France, in 1887, where more than four hundred people were poisoned by wine containing arsenic, mention is made of a case in which the epidermis of the soles, particularly about the heels and balls of the toes, became hard and dry and horny.‡ In the same year, at a meeting of some branches of the British Medical Association, held at Gloucester, Mr. Jonathan Hutchinson called attention to several cases of keratoses of the palms and soles, due, he thought, to the ingestion of arsenic. He thought it probable, too, that the drug might cause a peculiar form of cancer.§

The whole subject received important contributions in 1891 by the publication and discussion of three English observations on palmar and plantar keratoses.|| The third of this series was reported by Pringle as one of "Keratosis of the palms and soles probably of arsenical origin." The patient was a young woman, suffering from psoriasis, who took Fowler's solution for one year. It was then noted that the epidermis of the palms and soles was thickened and keratotic in patches, varying in size from that of a pin's head to that of a pea, so that the skin presented a warty appearance. The affection extended along the lateral borders of the fingers. The description tallies in the main with the case before us. Pringle presented his patient before the Dermatological Society of London, where Mr. Hutchinson gave it as his opinion that the case was one of arsenical keratosis. Considering all of this evidence, there can be at present no doubt as to the existence of such a condition.

The lesion appears after some months or years of arsenical medication, either as a diffuse hypertrophy of the epidermis, or there arise local thickenings of all sizes, giving to the skin a warty appearance. Most frequently, perhaps, the two conditions are combined. Rarely is there any erythema, a circumstance which distinguishes it from the hereditary palmar and plantar keratoses. The palms and soles are usually involved, though, as in this patient, the dorsal and lateral aspects of the fingers and elbows may be affected. As it appears on the

\* Klin. Wahrnehmungen u. Beobachtungen, Berlin, 1851, S. 228.

† Jour. of Cut. Med., 1868, Vol. I, p. 355.

‡ Barthelemy: quoted by Rasch, op. cit., p. 153.

§ An address on the study of skin diseases as illustrating the doctrines of general pathology. Brit. Med. Jour., 1887, II, p. 230.

|| Brooke: Brit. Jour. of Dermat., 1891, p. 19. Crocker: *ibid.*, p. 169. Pringle: *ibid.*, p. 390.

elbows it recalls the condition of psoriasis, hence Mr. Hutchinson's term "arsenical psoriasis."

By what mechanism the lesion is produced is far from clear. Excessive sweating of the palms and soles has been observed during the long-continued administration of arsenic. It may be that, owing to this hyperhidrosis, arsenic is excreted in the sweat in an unusual amount and that the prolonged contact of the drug in these regions may determine the localization of the lesion. The appearance of the "corns" about the apertures of the sweat-glands has been noted in a few instances.

When the arsenic is withdrawn the keratosis usually remains stationary or slowly diminishes. Active treatment with such preparations as salicylic acid should not be undertaken without bearing in mind a third and less fortunate termination of these keratoses, to which Mr. Hutchinson\* drew attention at a meeting of the Pathological Society of London, in 1887. Here he elaborated the proposition which he had made at Gloucester that the internal administration of arsenic could be the cause of a "peculiar form of cancer." He presented notes and drawings of three cases in which, following the use of arsenic, not only palmar and plantar keratosis developed but also malignant growths. His thesis drew forth some opposition, but Sir James Paget, who occupied the chair, remarked that he "had seldom heard an argument founded on clinical and pathological evidence more definitely suggesting the conclusion advanced." Mr. Hutchinson's first case was that of a man suffering from psoriasis who had taken arsenic for many years. "Corns" developed on his hands and feet. A corn on the sole of the foot ulcerated, resembling at first a perforating ulcer. According to Sir James Paget's opinion, "the disease was cancerous." Microscopical examination was inconclusive. The growth was removed; the patient recovered.

The second case was one of unusual interest. An American physician had taken arsenic for psoriasis for a long period. The psoriasis was cured, but the skin of the palms and soles became rough. Fungous ulcerations appeared on both hands. Ultimately both hands were amputated. Eighteen months later the patient died. Metastases of epithelioma were found in the left axillary glands, in both lungs, in the suprarenal glands, and in a rib. I shall refer to this case later on.

Finally, the case of a clerk, aged 34 years, who had taken arsenic for a long time for psoriasis, was cited. When he appeared at the Skin Hospital the palms and soles were dotted with "corns." Then an epithelioma of the scrotum appeared. It was excised, but the subsequent movements of the patient could not be followed.

Now, the facts which were thus brought forward were not unknown, but Mr. Hutchinson's interpretation was novel. Thus, in 1874, an epithelioma taken from the foot of an individual suffering from psoriasis is exhibited before the Anatomical Society of Paris.† A few years later, Cartaz‡ reports to the same society the case of a man forty years of

age, suffering from psoriasis, in whom a cancerous ulceration developed over the palmar surface of the right ring finger.

Both patients showed keratoses. They had presumably been treated with arsenic as is practically every case of psoriasis though no mention is made of this fact.

In 1885, Dr. J. C. White,\* published an article with the title: "Psoriasis, Verruca, Epithelioma, a sequence." Two cases are reported. The first patient was a man who had had psoriasis of many years' standing. He had taken arsenic in considerable doses. For ten years he had had keratoses on his hands. Three years previous to his examination by Dr. White in 1884 one of these "warts" on the anterior aspect of the right palm ulcerated and a similar but less extensive change took place on the left palm between the fore and middle fingers. The ulcers were viewed as epitheliomata, but before resorting to a radical operation, the patient sought the advice of Mr. Hutchinson and others in Europe. Mr. Hutchinson has pictured the patient's hands in his *Archives of Surgery*.† To his opinion and the subsequent history of the patient I have already alluded in referring to his second case. Let it be added that microscopically the growths proved to be epitheliomata. Dr. White at the same time reported the case of another man, 52 years of age with psoriasis of long standing, warts on the hands and an epitheliomatous ulcer on the anterior aspect of the right wrist and palm. He, too, had been subjected to an arsenical treatment. White considered the psoriasis as a cause of carcinoma through an intermediate lesion, the wart. At that time arsenical keratosis was not recognized. Even now in hearing the reports of these cases of "arsenical cancer," to use Mr. Hutchinson's term, the fact that all the patients were subjects of psoriasis must draw the critic's attention. It may be true that psoriasis with its hyperplasia of the epidermis predisposes to the formation of epithelioma in individuals submitted to continued arsenical medication, but that it is not a necessary condition is illustrated by a case of Ullman,‡ presented to a society of physicians in Vienna in 1898. The patient, a young woman, had been taking Fowler's solution seven or eight years for a facial acne. A palmar and plantar keratosis followed. During the preceding year an epithelioma appeared on the face. It was extirpated. Six months later, another epithelioma which had developed on the thickened skin of the heel, was removed. Here the cutaneous disease, the acne, can have played no rôle, not even that of a predisposing factor, in the development of the new growth. Still more conclusive are the reports of the cases from Reichenstein.§ The three individuals whose histories, Geyer gives had all been saturated with the arsenical drinking water; had acquired the "Reichenstein complexion," and keratosis of the hands and feet. Each suffered from an epithelioma of the right hand.

In a majority of the cases I have now reviewed, the cancer has appeared either on the hands or feet, regions peculiarly susceptible to arsenical keratosis. Indeed, where the details have been carefully observed, it has been noted that the

\* Brit. Med. Jour., 1887, II, p. 1280.

† Pozzi, *Bullet. de la Soc. Anat.*, 1874, p. 587.

‡ *Bullet. de la Soc. Anat.*, 1877, p. 549.

\* *Am. Jour. of Med. Sc.*, 1885, Vol. LXXXIX, p. 163.

† 1891, Vol. II, plate XX.

‡ *Ann. de Derm. et de Syph.*, 1898, t. IX, p. 481.

§ *Op. cit.*



FIG. 1.—Shows the diffusely thickened skin of the palm, the deepening of the cutaneous furrows and the scattered keratosis.

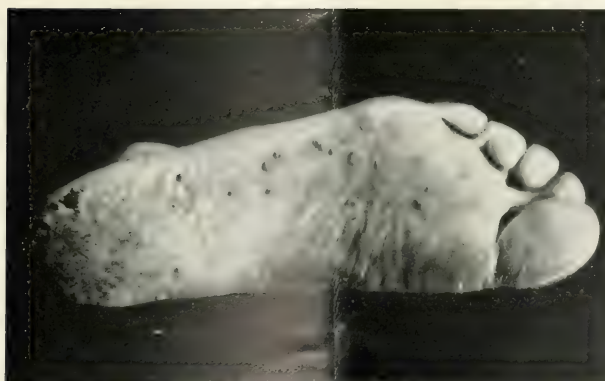


FIG. 2.—Shows the horny excrescences on the sole of the foot. Their distribution suggests the pressure of the shoe as a determining factor in their localization.





epithelioma most often arises directly from these keratotic patches.

This fact is not remarkable, knowing how frequently the keratoses of old age undergo a similar change. Nor is it surprising that the "arsenical warts" of the right hand, constantly exposed to trauma and irritation, most often suffer these changes.

In one of Mr. Hutchinson's cases, the scrotum was the seat of the epithelioma. This localization is of interest in view of the fact that it is an old observation, that the external genitalia are points of predilection of arsenical lesions. Dr. Paris writing in 1825 concerning the poisonous effects of arsenious acid on plants and animals states that "the smelters are occasionally affected with a cancerous disease of the scrotum similar to that which infects the chimney-sweeps."\* You see that the very localization of the epitheliomata in these cases favors Mr. Hutchinson's proposition that arsenic "may be the cause of cancer."

To sum up: The present case has given us an opportunity to review a number of interesting and important facts in connection with the administration of arsenic. We have seen that its prolonged use is at times attended with wide-spread pigmentation or keratosis chiefly palmar and plantar, or both pigmentation and keratosis. Associated together, they form a picture which can scarcely be mistaken. The keratosis may in rare instances undergo epitheliomatous changes and lead to a fatal termination. The possibility of such a serious outcome, let alone other accidents of arsenical intoxication, emphasizes once more that arsenic is no indifferent drug. The occurrence

\* Quoted in Butlin's Lectures on Cancer of the Scrotum. Brit. Med. Jour., 1892, Vol. II, p. 67. See also, Brouardel, *Troubles de l'appareil cutané dans l'arsenicisme*. Gaz. hebdomadaire de Médecine et de Chirurgie, 27 juin, 1897, p. 603.

of these dermatoses, however, is not to be viewed as the result of a medical error in its administration. Its use continued for months, and at intervals even for years, is the only relief on which many sufferers from psoriasis can rely.

As with other drugs the range of individual susceptibility is wide. While one will develop a keratosis after a few months of arsenical medication, another may take the drug for years with impunity. Mr. Hutchinson has recorded a life-long use of arsenic for the relief of psoriasis in a man sixty years old.\* Speaking generally, it had not interfered with his health.

Strange to say, too, I can find no record of these cutaneous accidents we have been considering among the Styrian arsenic-eaters. That arsenic may be habitually used without deleterious effects, and tolerance to large doses established, is illustrated by Mr. Hutchinson's case and the experience of the Styrian peasants, but such an immunity in medical practice is not the rule. Even Mr. Hutchinson's patient suffered from passing, but nevertheless profound, disturbances which might very well be attributed to the drug. From all of which I conclude that without a definite indication prolonged treatment with arsenic is an error.

A common acne may be combated by simpler and less serious measures than years of arsenical medication! On the other hand, as I have just said, for certain cases of psoriasis and let me add, of lichen ruber, chorea, some grave anæmias, and occasionally for retarding the growth of various malignant tumors, the prolonged use of arsenic is a veritable boon. But in these instances its administration must be under medical supervision and not determined, as in the case of the patient before you, by his fears and opinions. "Virtue itself turns vice, being misapplied."

\* Arch. of Surgery, 1892, Vol. IV, p. 104.

## UNCONTAMINATED URINE.

By HOWARD A. KELLY, M. D., *Gynecologist-in-Chief, The Johns Hopkins Hospital.*

THE BEST WAY TO SECURE UNCONTAMINATED URINE FROM THE BLADDER AND FROM THE KIDNEY, AND HOW TO MINIMIZE THE RISKS OF CATHETERIZATION IN WOMEN.

The question of catheterization is ever a burning one, whether in the large clinic after important pelvic operations, where it is conducted on a wholesale scale, or in the case of the single patient at her home after confinement. In view of the frequent immediate untoward results of catheterization and their distressing sequelæ, I think we might almost reckon this procedure among the major gynecological operations, until the question as to the safest method is finally solved.

The first query of importance is, "Who shall catheterize the patient—shall the doctor or the nurse?" A little consideration will show that it would be practically impossible for the doctor, often at a distance and otherwise engaged, to add this to his already burdensome duties, and it must therefore be looked upon as distinctively a nurse's duty. (See Fig. 1.)

To this end the nurse must be especially trained; she must

be warned of the unusual risks and taught each step with great exactitude. The method I have adopted for some years past in my own clinics is the following:

I prefer to use a glass catheter, which I first tried in 1884, when I made one extemporaneously for an urgent case out of the glass tube of a baby's feeding-bottle; the glass is easily kept clean, and can be introduced *without touching the end which enters the bladder*. (See *Amer. Jour. Obs.*, February, 1889, p. 184.) (See *Kuestner Centralb. f. Gyn.*, 1890, No. 23.) (See also an excellent article by Prof. Kuestner, on glass catheters, as a means of prophylaxis against cystitis in women, *Deutsche med. Woch.*, 16 May, 1883.)

Each patient has her own catheter for her exclusive use as long as she needs one. It is sterilized by boiling five minutes in a soda solution and then placed in an open-mouth bottle

filled with 5 per cent carbolic solution, or 1-1000 bichloride of mercury with some cotton on the bottom to protect the end of the catheter.

Just before using it may be boiled again in the soda solution.

The nurse then scrubs her hands carefully and places the patient on a bed-pan and exposes the vulva and separates the labia so as to expose the urethral orifice.

She now takes up a pledget of cotton, saturated with a boric-acid solution, in the grasp of a forceps, and with this thoroughly cleanses the urethral orifice. This is repeated with another pledget when the patient is ready for catheterization. (See Fig. 2.)

She now draws two sterile finger-cots over her thumb and index finger of the right hand, and thus well protected grasps the catheter by its outer end and removes it from the receptacle, rinses it off with sterile water, or if it has just been boiled lifts it directly from the pan, and gently introduces it into the urethra, allowing it to take its own way into the bladder and never under any circumstances using force.

I desire here to point out the fact that the catheter never completely empties the bladder when the patient is lying down; and if there is any cystitis it is best to wash it out, using a large catheter with a strong curve at its vesical end. After the irrigation the curved end is turned downwards towards the base of the bladder, when the sediment often escapes first.

Uncontaminated urine may be obtained from the bladder for bacteriological study in the following manner:

The catheter is sterilized with a piece of rubber tubing covering an inch or more of its outer end and projecting about 2 inches beyond it. It is then introduced, preferably

by the physician, with the precautions described, and the urine allowed to escape for a few seconds, after which the rubber sleeve is pulled off and the urine now running over the sterilized end of the catheter is collected in a test-tube. In my investigations of several hundred specimens in this way conducted with my associate, Dr. Thos. R. Brown, we have had no cases of accidental contamination. In twenty instances sterile urine was taken as a control experiment and in every case it remained sterile. (Fig. 3.)

In securing uncontaminated urine from the kidney, I proceed in a similar manner. The bladder is washed out and emptied, and the patient is put in the knee-breast posture and the urethral orifice exposed. This may now be cleansed with a little pledget of boric-acid solution and the catheter introduced.

The catheter is sterilized with a rubber sleeve protecting and projecting beyond the end. The operator draws on the hand which grasps the catheter a sterilized half-glove, which I have had made for this purpose, and grasping the catheter, protected also if need be by a sterile towel on his shoulder, he introduces the end into the ureter and pushes it on up into the kidney. The patient is then allowed to lie down on her side or on her back, the sleeve is pulled off, and the sterile end of the catheter is put in a sterile test-tube held in place by the cotton plug.

I have done this not less than sixty times and have never yet seen an accidental contamination.

It is evident, therefore, that by this procedure, when the ureter is catheterized by my method through the open speculum in an air-distended bladder, we possess a method of securing cultures from infected kidneys which is impossible in any other way short of a surgical operation.

## SUMMARIES OR TITLES OF PAPERS BY MEMBERS OF THE HOSPITAL AND MEDICAL SCHOOL STAFF APPEARING ELSEWHERE THAN IN THE BULLETIN.

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HARVEY CUSHING, M. D. Exploratory Laparotomy Under Local Anesthesia for Acute Abdominal Symptoms Occurring in the Course of Typhoid Fever.—*Philadelphia Medical Journal*, March 3, 1900.

NORMAN B. GWYN, M. D. The Examination of the Urine for Typhoid Bacilli.—*Philadelphia Medical Journal*, March 3, 1900.

ROBERT REULING, M. D. Changes in the Skin in Paralysis Agitans.—*Maryland Medical Journal*, March, 1900.

ROBERT REULING, M. D. Pathology and Neurology.—*Maryland Medical Journal*, March, 1900.

GEORGE WALKER, M. D. Electrolysis as a Means of Curing Chronic Glandular Urethritis.—*Maryland Medical Journal*, March, 1900.

THOMAS R. BROWN, M. D. Internal Medicine.—*Maryland Medical Journal*, March, 1900.

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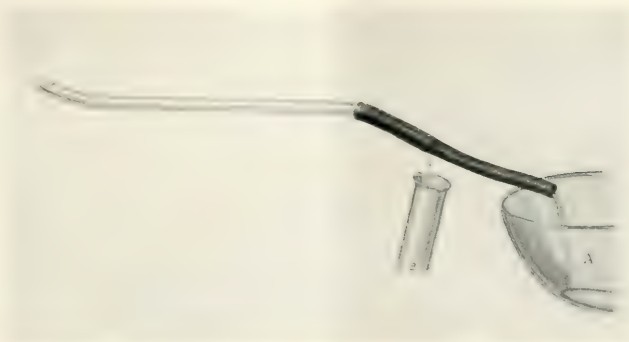


FIG. 1.—The sterilized glass catheter, protected by a rubber sleeve. When first introduced, a little urine is allowed to escape into the vessel A; then the rubber sleeve is pulled off, and uncontaminated urine runs directly from the end of the glass tube into the sterile tube B.



FIG. 2.—Shows the nurse holding the catheter with fingers protected by sterile rubber finger cots, while the urine escapes from the sterile end into the glass tube upon removal of the rubber protecting sleeve.

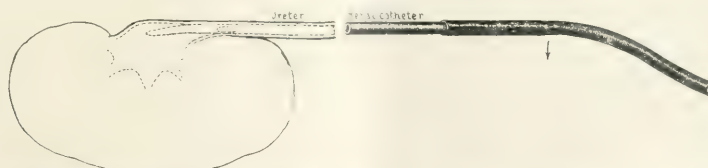
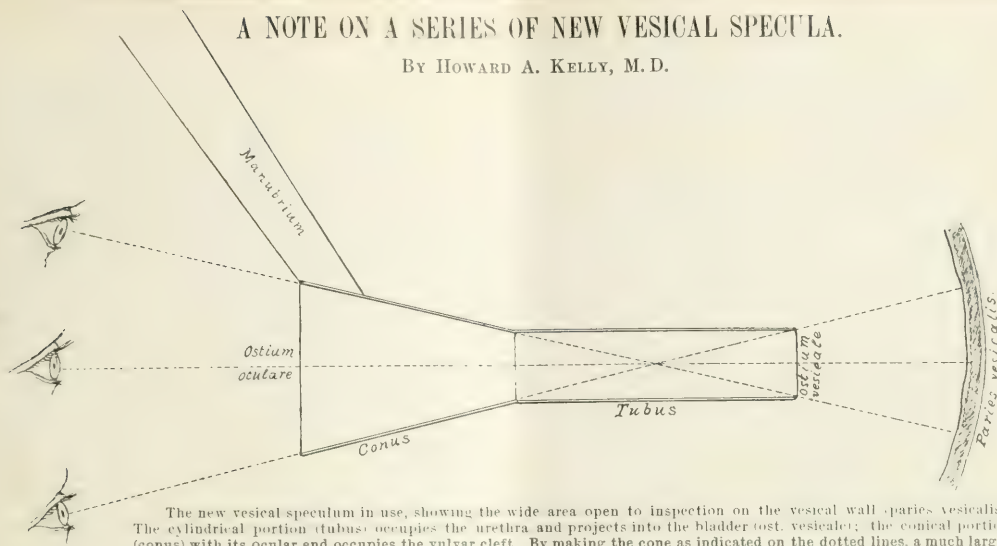


FIG. 3.—The renal catheter protected by the rubber sleeve. On introduction, the sleeve is pulled off and the end of the catheter, marked by the arrow, inserted in a sterile tube and uncontaminated urine collected.



## A NOTE ON A SERIES OF NEW VESICAL SPECULA.

BY HOWARD A. KELLY, M.D.



The new vesical speculum in use, showing the wide area open to inspection on the vesical wall (pariet vesicalis). The cylindrical portion (tubus) occupies the urethra and projects into the bladder (ost. vesicalis); the conical portion (conus) with its ocular end occupies the vulvar cleft. By making the cone as indicated on the dotted lines, a much larger field is secured for inspection and for instrumentation. The tube in some cases may with advantage be made 2 cm. longer, when it projects further into the bladder and serves to push up the base of the bladder in inspecting it.

The open cylindrical vesical speculum when in use is topographically divided into a urethral and a vulvar portion.

The calibre of the urethral portion is limited by the degree of safe or convenient distention of the urethra, and in the average specula ranges from No. 9 to No. 12 (the numbers in my scale representing millimetres in diameter); in the larger sizes, used for operations, the calibre may even be carried as high as 20 mm., the limit of a safe degree of dilatation, as shown by Simon.

The vulvar portion, however, has no such necessary limitations and may, as I have found, be expanded with great advantage into a broad funnel. The best form of funnel is one in which the angles formed by the lines of the slanting sides meet exactly in the middle of the tubular portion. This gives a maximum area of inspection and a maximum room for treatment, especially in using instruments with crossed blades. The length of each of these parts of the speculum should be 5 cm.

## PROCEEDINGS OF SOCIETIES.

## THE JOHNS HOPKINS HOSPITAL MEDICAL SOCIETY.

Monday, February 19, 1900.

**The Pathological Findings in a Case of General Cutaneous and Sensory Anesthesia.**—DR. BERKLEY. (See BULLETIN for March.)

**SPECIMENS OF FALSE PORENCEPHALIA.** DR. BERKLEY. —The person from whom this specimen was obtained was a medium-grade imbecile, who had lived to reach the age of 58 years. He was tall, with fairly developed musculature, and without marked cranial deformity. At the autopsy, the brain weighed 950 grammes. The convolutions on the external aspect of the hemispheres were without any marked asymmetries, but the right half of the brain was considerably smaller than the left, and when taken out of the bony envelope, flattened perceptibly. On closer examination, a defect was found on the median-inferior aspect of the hemisphere, measuring four centimetres in its greatest length by two in its greatest

width. The anterior margin lay considerably forward of the splenium of the corpus callosum, the posterior end stopped three and a half cm. before the tip of the occipital lobe. The defect was separated from the ventricle by a leathery substance, from 1.50 to 1.75 mm. in thickness. This showed no trace of cerebral matter. The lesion formed a pocket beneath the general level of the surrounding brain-tissue, which was filled with a gelatinous mass. The convolutions involved were portions of the posterior end of the convolution of the corpus callosum, the anterior and middle parts of the lingual convolution, the innermost aspect of the occipito-temporal gyrus, and a large part of the convolution of the hippocampus. The cuneus was not disturbed. The foot of the hippocampus was not entirely destroyed, its anterior portion retaining some of the nerve elements. In the posterior portion of the hippocampus the traces of an old hemorrhage were found, showing that the lesion had originated in the rupture of a blood-vessel. The corpus callosum throughout its whole extent was poorly developed, but the posterior half was especially thin, an evi-



dence that the injury to the cortex had taken place in early life, and that the hemispheres had not fully developed thereafter. When the right and left sides of the corpus callosum were compared in the cross-sections, the left side was seen to be thinner than the right. There were no indications of localized brain lesion during life.

**On a Form of Conjugation of the Malarial Parasite.—DR. EWING.**

In four cases of tertian infection the writer has encountered appearances in the blood which seem to admit of no other explanation than that of conjugation of malarial parasites. In a considerable number of other cases similar appearances were found, but much less frequently.

The blood in these cases showed a large number of young rings and many half-grown and full-grown forms. A great many cells showed double infection with young rings. In many instances these rings were entirely separate, each exhibiting a single large granule of chromatin. Many cells, however, contained two rings, which were clearly fused together along one segment of the ring, and two large chromatin granules were then invariably found at different points in the rings. The fused parasites usually differed in appearance. One was a large delicate ring with a thin bow, and chromatin granule of moderate size, while the other was a coarser body with thickened bow, enclosing little or no hemoglobin, and exhibiting a large chromatin granule.

Among the single rings, these two forms of young parasites were often distinguished, but no single rings could be found containing two equally large chromatin granules, while every red cell that exhibited two large and equal chromatin granules contained also two distinct rings. It appears, therefore, that the bodies of many parasites had become fused together, while their nuclei remained separate.

On examining the parasites in later stages of development, most of them were found to have lost the ring form and to have spread out into a large number of threads, with nodal thickenings variously curled in the red cell. These threads evidently represented the pseudopodia of a very active amoeboid stage. The chromatin masses were now subdivided into ten or twelve granules; but, in the majority of the cases, these masses were far apart and showed no tendency to unite. In many cells, however, the amoeboid figures were less marked, and the masses of chromatin lay side by side, united by a little achromatic substance. Later some parasites were found in which the two groups of rather large chromatin granules lay in immediate apposition, surrounded by achromatic substance. This phase was marked by a distinct reduction in the length of amoeboid figures.

Many older spheroidal, hyaline forms, belonging to this same brood, were found in these cases, but all the older hyaline forms were single, and exhibited a single large group of fine chromatin granules. Not one cell harboring two full-grown parasites could be found in prolonged and repeated searches through several slides. Whatever interpretation may be placed upon this peculiar absence of older twinned forms, the finding of all stages of union, first of the bodies and later

of the nuclei, likewise appears to admit of no other explanation than that of conjugation.

DR. WELCH.—I have been greatly interested in Dr. Ewing's paper, and consider that the Society is to be congratulated upon this opportunity to listen to his personal presentation of these important observations. There can be no question as to the accuracy of these observations, whatever difference of opinion there may be in their interpretation. Most of the questions which had occurred to me in the course of Dr. Ewing's remarks, he answered before their conclusion.

The most important question seems to me whether the conjugation of parasites described by Dr. Ewing, is to be looked upon as something essential, really pertaining to the life history of the organism, or as merely a more or less accidental coalescence, or fusion, of two cells. Of such fusion of cells we have some examples in normal and pathological processes, and if this latter be the proper interpretation, there may be some question as to the propriety of the designation "conjugation," which has a special meaning among biologists. I do not know that Dr. Ewing is in a position to express himself more definitely upon this point.

DR. THAYER.—We all, I am sure, feel grateful to Dr. Ewing for the very interesting communication which he has made. I regret extremely that Dr. Lazear is not here to take part in the discussion, inasmuch as he has for the past year been making careful studies in this line. Unfortunately, he has gone to Cuba, and his specimens and the paper which I had expected to have in time to read to-night have not been received.

Dr. Ewing's interpretation of his interesting observations is extremely suggestive. I recognize many of the pictures which have been described, but I must confess that their possible importance had escaped me. I have, without much thought, always assumed that the reason why twin parasites were relatively common in the early stages of development of the organism and so infrequent later on was that with the growth of the several contained organisms the red blood-corpuscle was eventually ruptured, both parasites escaping and meeting the fate which apparently inevitably befalls extracellular bodies at this stage of development. But, after all, this is a pure hypothesis, and in view of Dr. Ewing's careful studies I should surely feel called upon to thoroughly restudy the question before venturing to dispute his conclusions.

A rather interesting point in connection with this matter, if we are to regard the process as one of fusion, is that at a certain stage the structure of the organism might justify the term *plasmodium*, the biological inaccuracy of which as applied to the ordinary parasites has been so generally recognized.

In connection with the possibility that this process might be a true conjugation, a rather inviting, though I fear improbable, explanation of its possible significance suggested itself to my mind.

In the aëstivo-autumnal parasite, for instance, beside the organisms pursuing the ordinary cycle of development, there soon appear other bodies morphologically distinct from these, the crescentic and ovoid forms. These forms, Mannaberg

contents, are the result of conjugation of two elements belonging to the ordinary cycle.

Only from the bodies belonging to the crescentic group do the sex-ripe forms (macrogametes and microgametocytes) develop.

In a recent communication Bastianelli and Bignami assert that the sex-ripe forms in the tertian parasite likewise develop from elements morphologically distinguishable from those belonging to the ordinary cycle.

What causes the differentiation of the crescent group in the æstivo-autumnal parasite and of the group destined to develop into sex-ripe forms in the tertian parasite? May it be that these sex-ripe forms in both instances develop only as a result of conjugation of two bodies, each of which alone would be capable of pursuing only the ordinary asexual cycle—that the process observed by Dr. Ewing is a necessary stage in the production of elements destined to develop into flagellate forms (microgametocytes) or macrogametes?

I am, however, unaware whether there is any analogy to justify such an hypothesis—and what is more important the fact that the crescents are formed as a result of conjugation is by no means settled. Indeed, we are inclined to believe, with the Italians, that this is not the case.

DR. MACCALLUM.—I would like to ask one or two questions of Dr. Ewing. 1st, Whether he has seen any actual fusion of the chromatin bodies, or whether they simply lie side by side as he has pictured them; and, 2d, What happens after this—whether there is any difference between the conjugated forms and the others. As I understood him, they both go on to sporulation; and it struck me as an occurrence which has its parallel in certain lower animals, that conjugation should take place in these young immature cells. I would also like to know whether he has observed this only in one cycle or in several successive cycles.

DR. EWING.—When I made up my mind to read this paper in Baltimore, it was with the idea that I could obtain more information here than anywhere else on a point which concerns the minute morphology of the malarial parasite. This decision seems to have been justified, and I feel that I am now in a better position to consider the importance of this process.

Dr. Welch has hit the nail on the head in regard to the significance of the process. I am fully convinced that all the stages I have described actually occur, but it is a totally different thing to ascribe to such a process its proper interpretation. I am inclined to think that this process has not the full significance we find it to have in certain lower animals where conjugation is a *necessary* preliminary to sporulation. It is certainly not so of the malarial organism. I only claim that it occurs frequently, and is a real fusion of parasites, undergone for convenience, perhaps, but is not an essential preliminary to sporulation. I thank Dr. Welch very much for making the suggestion that clearly places the process in its correct position.

I confess that I had not had in mind the possibility that when two parasites conjugate the result might be the rupture of the cell and death of both parasites. I had suspected that some one might claim that one parasite, gaining the upper-

hand, had destroyed the other, but it had not entered my mind that both might be thrown out.

Now, what can be said as to the possibility of such a process occurring? It seems to me that if it does occur with any frequency, it would occasionally be observed in some specimen; and it seems, on general principles, extremely unlikely that if such a rupture and extrusion occurs, we should examine hundreds of specimens and fail to find any trace of such a process. I have been over these slides until my eyes hurt, and have not found any traces of the rupture of cells and extrusion of twin parasites. The suggestion is an extremely good one, however, and I shall hereafter bear it mind. I am somewhat surprised that I did not think of it before, and I want to thank Dr. Thayer for the suggestion.

In regard to Dr. Thayer's suggestion concerning the relation of this process of conjugation to the life history of the parasite and preparing it for growth in the mosquito, I have not allowed myself to draw any conclusions whatever on that point. I am inclined to think, with Dr. Welch, that it is a mere fusion taking place when they are very numerous, and has probably nothing to do with the development of flagellate bodies or of any form especially adapted to growth in their new host. It seems rather to increase the numbers of young parasites produced in the human host. I was unable to trace the full development of some of the single parasites. This, also, is an extremely important point, and is the one I had foremost in mind in discussing the subject. I have noticed in these conjugating specimens that I can hardly ever get any flagellate bodies.

Dr. MacCallum wishes to know if I have actually seen fusion of the nuclei. I have not. I do not see how it is possible in the fresh specimen to accurately follow the process of union of masses of chromatin, such as we are dealing with here. My experience is that only the grosser processes can be identified with certainty by such means, and I feel that the identification of the nuclear bodies in the fresh specimen, as concerned in this process, would be unreliable in my hands. I should prefer to leave that to some one more familiar with the study of fresh-blood specimens. I do believe very firmly, however, that such union of nuclei does occur, from study of stained specimens. The same answer applies to his last question: Have I followed the development through several generations or only in one? I have not been able to follow up more than one generation, because we are in New York seldom able to follow these cases long. In the cases of the soldiers at Montauk, I had to take many specimens within a few minutes and usually saw the patient but once.

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# BULLETIN

OF

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## URINARY ANOMALIES.

- I. SIMULATIVE NEPHRITIS.
- II. POST-OPERATIVE GLYCOSURIA.
- III. MALINGERING MELITURIA.

By THOMAS R. BROWN, M. D.

### I. SIMULATIVE NEPHRITIS (after Nephrotomies and Nephropexies).

The exact etiology of nephritis is still such an unsolved problem that anything that has the least bearing on even the smallest part of this problem should, we think, prove of some interest.

Besides the fact that a nephritis may be brought about by exposure to cold or by the action of various poisons—as those of the specific fevers, various chemical substances, and the toxins produced by skin-burns—very little is known of the cause of the condition.

I wish in this brief communication to report an interesting form of urinary anomaly, which I have designated by the name of “simulative nephritis,” occurring after certain simple operations upon the kidney.

These operations of nephropexy, or stitching the kidney in place, have become quite common within recent years, due to the work of Glénard and his school, and the demonstration by them of the characteristic and distressing symptom-complex noted in those suffering with a falling, or ptosis, of the kidneys, or “nephroptosis;” while we may also have a falling of many of the abdominal organs, usually associated with symptoms of a similar nature to those seen in cases of nephro-

ptosis, Glénard designating these conditions as “gastroptosis,” “hepatoptosis,” “splenoptosis,” according to whether the stomach, liver, or spleen is displaced, while a general displacement of all the abdominal viscera is known as “enteroptosis.”

My attention was first called to the urinary peculiarities, after operation for floating kidney, by a case (Case I)—seen for the first time last year—in which the patient complained of severe pain in the left renal region, and, as nothing seemed to relieve it, an exploratory nephrotomy was decided upon.

The urine had been examined on four occasions previous to the operation, and was found to be perfectly normal, except for a number of red blood-cells and the amount of albumin one would expect with such a degree of hematuria, brought about by catheterization of the ureter, on the last two examinations. The operation consisted of an exploration of the kidney, an artery forceps being forced through the renal tissue into the renal pelvis to determine whether or not a stone was present; and, after the negative results of this examination, the closure of the renal wound and the stitching of the kidney to the posterior abdominal wall.

On the day following the operation the urine, of specific gravity 1.022, besides containing many red and some white

blood-cells and epithelial cells, contained enormous numbers of casts of all kinds—hyaline, finely and coarsely granular, blood and some epithelial—the microscopic field being simply crowded with them. The urine contained a considerable amount of albumin, but no sugar.

In six days the urine, of specific gravity 1.026, had cleared up considerably and contained but a trace of albumin and few blood and epithelial cells, but there were still a number of hyaline casts, and a few granular, blood and epithelial casts; while ten days later the urine, now of specific gravity 1.017 and showing but a faint trace of albumin, still showed a few hyaline casts and now and then a granular or epithelial cast, with a few red and white blood-cells and epithelial cells.

A bacteriological examination of the urine made at the height of the condition showed that it contained no micro-organisms. The urine was obtained under the most careful aseptic conditions and cultures made upon the various media, but the results were all negative.

The patient leaving at this time, the urine was not again examined for several weeks, when it was found to contain neither albumin, blood-cells, nor casts; and again, ten months after the operation, the urine was found to be absolutely normal.

Associated with this urinary condition there had been absolutely none of the symptoms of a nephritis, no edema of the legs, no ascites, no retinal symptoms, no more headache and nausea than would be expected after ether anesthesia; while the quantity of urine voided was about the same as is usually seen after the administration of ether by inhalation.

The most striking characteristic of the urine was the marked disproportion between the number of casts and the amount of albumin present, the latter being so much less than one would expect from the great number of the former.

Since this case, which was regarded as being of peculiar interest, I have followed, as carefully as the circumstances would allow, all the cases of nephropexy that came within my reach.

In all, four such cases have been followed carefully, while in two other cases the urine was examined at a quite considerable time afterwards; but, as we shall see shortly, the results of this late examination are of slight interest, as the study of the other four cases has demonstrated that an early examination is absolutely essential.

In two of these four cases, in which the urine was examined immediately after operation, it was found to be normal except for a trace of albumin and a few blood-cells as one would naturally expect after the operation performed; no casts were seen after a most thorough search.

In the other two of the four cases carefully studied, however, the conditions found were, I think, of sufficient interest to warrant their being described at greater length. In the first of these the urine on the day before the operation was acid, of specific gravity 1.018, containing neither sugar nor albumin, while a microscopic examination showed only a few uric acid crystals and threads of mucus. On the day following the operation—a simple nephropexy—the urine contained a small amount of albumin, but an enormous number of casts, mostly hyaline, some granular, and an occasional

blood-cast, with some red and a few white blood-cells and epithelial cells.

On the next day, there was but a trace of albumin, a few red blood-cells and very occasional white blood-cells and epithelial cells, but still hyaline casts in moderate amount, while two days later both albumin and casts had entirely disappeared.

The patient was in a rather poor general condition, and her blood contained but sixty-one per cent of hemoglobin.

The second case was very similar, showing on the day preceding the day of operation a normal urine of specific gravity 1.020 with no sugar, no albumin, and a few epithelial and pus-cells (voided specimen), while on the evening of the day of operation, the urine of specific gravity 1.016, while showing but a trace of albumin, showed enormous numbers of casts, hyaline, finely and coarsely granular, and blood-casts with a few free red blood-cells and epithelial cells.

On the following two days the urine contained but a trace of albumin, the specific gravity was 1.020 and 1.028 respectively, while on the first of these two days the sediments still showed enormous numbers of casts though not in quite so great abundance as the night before (mostly hyaline and granular with a few blood and epithelial casts), with a few red blood-cells and epithelial cells and occasional white blood-cells, while on the second day the only casts present were the hyaline and finely granular, which were still quite numerous, with an occasional red blood-cell, white blood-cell and epithelial cell.

Five days later the albumin and casts had entirely disappeared, and the only things seen in the sediment were occasional red and white blood-cells.

In the other two cases, the urine was not examined until the fourth and seventh day respectively after the operation, and neither casts nor albumin were found in either, but only an occasional red and white blood-cell.

These latter cases, however, as mentioned before, are of little interest because of the lateness of the urinary examination. Thus, of five cases in which the kidney was stitched in place, in three we have found in the urine what would lead one on microscopic examination to make a diagnosis of acute nephritis, and yet associated generally with but a trace of albumin, and having none of the clinical signs and symptoms of such a disease.

In all the cases the urine was perfectly normal before the operation and after this transitory cylindruria. We have, evidently, four factors distinctly involved in the production of this condition: 1st, the handling of the kidney, usually quite slight, except in the first case, in which a nephrotomy was also performed, and where the cylindruria and albuminuria persisted for a much longer period of time; 2nd, the taking of the stitches through the renal substance, and, in the first case, the trauma necessary in an exploration of the renal pelvis; 3rd, the irritation of the renal tissue by the ether that is, in part, eliminated by means of the kidneys—a well recognized condition as shown by the fact that a definite nephritis occasionally develops after protracted operations under ether anesthesia, this point having been gone into in detail very recently by Galleazi and Grilo (Gior. d. R. Acad-

mia di Torino, 1899, p. 293): 4th, the diminution in the elimination of fluids which is almost invariably seen after ether anesthesia, and which undoubtedly subjects the kidney to a greater chance of becoming diseased.

Probably in the development of this "simulative nephritis," all these factors play a part, although the stitching and handling are probably of most importance as evidenced by the fact that the urinary condition was so much more marked and persistent in the case where the trauma and handling were greatest, viz: the first case, where both a nephrotomy and a nephropexy were performed.

In connection with the effect of trauma upon the kidneys a recent article of Professor Stern, of Breslau (*Monatschrift für Unfallheilkunde*, 11, 1899), is of interest.

He considers in this article the definite relation between trauma and the development of nephritis, and after mentioning the extreme rarity with which nephritis develops after injuries, blows, falls, or contusions in the kidney region, describes the following conditions which may arise after such injuries:—1st, cases which either rapidly end fatally or are rapidly cured, in which the urinary picture is that of an acute nephritis, but with more albumin than one would expect from the number of red blood-cells; in the cases that came to autopsy an extensive renal necrosis was to be made out, but no nephritis; 2nd, cases of long-lasting albuminuria with casts in the urine, without the general symptoms of a diffuse nephritis: the condition may last for more than a year but is extremely rare, and, so far, no autopsy records are to be had of such cases; probably these are cases of circumscribed inflammatory processes following the renal trauma; 3rd, typical cases of diffuse nephritis after trauma; in the literature a number of such cases are to be met with, with the characteristic urinary picture, and also the oedema, retinal changes, uræmic manifestations, etc; certainly in some of these cases, at least, a latent chronic nephritis was probably present before the injury.

While the number of our cases is small, it is probable that here also we may have analogues to the post-traumatic phenomena described by Stern, the extent of the condition probably depending upon the amount of trauma and handling which the kidney sustained during the operation, the amount of ether used, the general condition of the patient and the local condition of the kidney before operation.

Thus, in some cases we will only have the presence of a few red blood-cells and a trace of albumin rapidly clearing up; in others a urinary picture resembling a nephritis but less albumin than would be expected from the number of casts and cells present (differing in this respect from Stern's observations after trauma) and no other symptoms, the condition clearing up in a few days; in others a cylindruria and albuminuria of higher grade and longer duration, often lasting several weeks, but unaccompanied by other symptoms and finally clearing up entirely (examples of these cases are to be found in our five cases); while a longer persisting cylindruria with some albuminuria, and even a typical diffuse nephritis, must be considered as possibilities.

## II. POST-OPERATIVE GLYCOSURIA.

Since the original experiments by Claude Bernard, the subject of the disorder of metabolism, known as glycosuria, has been one of surpassing interest.

Certain experiments and discoveries have thrown some light upon the etiology of this condition, notably Bernard's celebrated *piqûre diabétique*, by which he showed that by puncture of a certain spot in the floor of the fourth ventricle polyuria and glycosuria could be produced; Lancereaux's, von Mering's and Minkowski's demonstration of the relationship which existed between certain pathological conditions of the pancreas and glycosuria; and the more recent work on alimentary glycosuria in various conditions, notably diseases of the liver, kidney and cerebrospinal apparatus, in which the organism is unable to appropriate the amount of sugar usually given (100 grammes) and some therefore passes into the blood, raising its sugar-content, and causing hyperglycemia and glycosuria.

It would be obviously unprofitable in an article of this kind to do more than touch upon some of the conditions in which glycosuria has been noted.

According to Abeles, Wedenski, Schilders, Moritz, Baisch and Kleen, there is a faint trace of glucose in normal urine, while Brunton has recently shown that after breakfast, the meal richest in carbohydrates, traces of sugar can usually be demonstrated in the urine.

Besides diabetes mellitus, the alimentary glycosuria and the physiological glycosuria just described, glucose has been found in the urine in a variety of diverse conditions, the condition usually being of low grade and transitory. Many cases of this nature have been reported, and to describe all the conditions in which glycosuria has been found would take me beyond the limits of this paper; it is of interest, however, to note some of the more important of these transitory glycosurias.

For convenience these cases may be divided into three groups: (1) the toxic; (2) those associated with diseases and injuries of various kinds, although probably in many cases of the latter group, a toxemia of some kind plays a considerable rôle in the etiology of the condition; and (3) puerperal glycosurias.

(1). *Toxic*.—Transitory glycosuria has been described after the use of amyl nitrite, mercury, hydrocyanic acid, sulphuric acid, alcohol, strychnia, glycerin, nitro-benzol, thyroid extract, lead, phloriazin, caffeine, diuretin, phosphorus, arsenic, carbon monoxid, morphia, tuberculin, pancreatin, while of the analgesics and anesthetics, a transitory glycosuria has been described after chloroform, chloral, amyl nitrite—in the case of the last-mentioned drug the sugar sometimes reaching two per cent—while Harley, Kleen and Von Jaksch describe the appearance of small quantities of sugar in the urine after ether, and Andral describes a case of true diabetes developing after ether anesthesia.

Of course, in some of these the only tests used were Fehling's or Trommer's tests, and recent work has shown that occasionally we find other reducing substances in the urine, especially glycuronic acid.



Thus, undoubtedly, in some of the cases described above the reducing substance was not glucose but glycuronic acid, as Marchot has shown with chloralamid; Ewald, von Mering and Magnus-Levy, with nitrobenzol and nitrotoluel; and Hoppe-Seyler with orthonitrophenylpropionic acid; thus, before we definitely prove the presence of glucose in the urine, besides Fehling's or Trommer's tests, the fermentation test, the polariscopic test, and the phenyl-hydrazin test should also have been made.

(2). *Associated with diseases or injuries.*—Transitory glycosuria has been described as occurring during the course of cerebrospinal meningitis, cholera, typhoid fever, relapsing fever, diphtheria, tetanus, phthisis, many of the exanthematous fevers, hepatic fibrosis and rickets. Frerichs has described it in gastritis; Da Costa in old age; Burdel during the malarial paroxysm; Rotch in scarlatinal nephritis; Ord in angina pectoris and chronic interstitial nephritis; Exner in cholelithiasis, though Rausch vigorously denies this; Marchot in syphilis; while after pertussis, asthma and a variety of other diseases, a faint trace has been occasionally found.

Of especial interest are those cases of transitory glycosuria found after injuries to the cerebrospinal apparatus and in various mental and nervous diseases. Thus, it has been described in cerebral, bulbar and pontine hemorrhage; after concussion of the brain or spinal cord; in cerebral tumor, abscess, softening and parasitic disease; in disseminated sclerosis; in epilepsy and epileptic insanity; in neuralgias of various kinds, especially sciatica; in exophthalmic goitre; in "a fatal case of myxedematous condition with tachycardia, melena and mania" (by Osler); in Friedreich's disease (by Best); in sexual neurasthenia (by Peyer); while it has been frequently seen in some of the functional neuroses, as Charcot's grand hysteria, the traumatic neuroses, neurasthenia, severe psychical derangements, and after great emotion.

Kleen has given the name "functional nervous glycosuria" to those cases where sugar appears in the urine in cases of acute or chronic "functional" nervous disturbances, and mentions several interesting cases where a transitory glycosuria was noted after grief, anger, excitement and other emotions of various kinds.

(3). *Puerperal glycosurias.*—Recent work has shown that a puerperal lactosuria is much more common than a puerperal glycosuria, although the latter is found in a certain number of cases.

Roque (Les glycosuries non diabétiques, Paris, 1899) makes the following divisions of the subject:

A. *Intermittent glycosurias of arthritics*, while as subheadings, are put the hereditary form in the young, the gouty form in the adult and old man, that of the obese, and the azoturic.

B. *Digestive glycosurias*, subdivided into that form seen after eating excessively of sugars, or carbohydrates; and that form seen in digestive disturbances.

C. *Nervous glycosurias* made up of those seen in the systemic affections of the nervous system, those seen in the neuroses and psychoses, and the traumatic glycosurias.

D. *Puerperal glycosurias.*

Hofbauer makes a somewhat different division of the transitory glycosurias, dividing them into the *neurogenic, febrile, toxicogenic* and *puerperal*.

itory glycosurias, dividing them into the *neurogenic, febrile, toxicogenic* and *puerperal*.

The cases I wish to report, three in number, are examples of transitory glycosuria after ether anesthesia. The first case was in a white woman of fifty-nine, who was successfully operated upon for carcinoma of the uterus, and hemorrhoids, and who had always been healthy, having had only whooping-cough, measles, chicken-pox, malaria and rheumatism, who had had eleven children and no miscarriages, and whose history and physical examination showed that the patient was not nervous at the time of her admission to the hospital and had never been so during her life.

For twenty years she had had a double pulsating goitre which had been associated with no symptoms whatsoever.

Owing to her pelvic trouble, she had had some frequency of micturition, but a careful urinary examination made on the day preceding the day of operation showed that the urine was absolutely normal, with neither albumin nor sugar present, of acid reaction and with only a few epithelial cells in the sediment.

On the day after the operation the urine was found to be of specific gravity 1.024; it showed some red blood-cells (due to the catheterization of the ureters); and, besides some albumin, contained between 2 and 3 per cent of sugar, tested for, qualitatively, by Fehling's and the phenyl hydrazin test; and, quantitatively, by the polariscopic and fermentation tests. On the next day about 1 per cent of sugar was present, while after the third day, on which a trace was found, no sugar was found in the urine during her subsequent stay in the hospital, although a daily urinary examination was made.

The convalescence was extremely uneventful, the temperature never rising above 99.6° F., and the patient showing rather fewer symptoms of nervousness than one would expect after an operation of such magnitude.

The condition was such a rare one that all the urinary records of the Gynecological Department were carefully examined to see if any other cases of like nature could be found.

Unfortunately in most operative cases there is but little need for a post-operative urinary examination, and there were comparatively few cases in which the urine was examined after the operation.

Two cases of very similar nature to the one I have described were found, however, as the result of this examination.

One of these was a colored woman of forty, who had a large myoma, which had been associated with much hemorrhage and pain, and which had left the patient in extremely poor condition; the expression was very troubled, the patient was very nervous at times, had a poor appetite, and slept very badly. Up to the beginning of the hemorrhages, however, the patient had been very healthy, pleurisy and inflammatory rheumatism ten years before being the only serious illnesses she had ever had.

The operation was merely an exploratory incision, the myoma being found to be absolutely inoperable; the patient was given three hundred and fifty grammes of ether in sixty minutes. The patient had suffered with burning frequent micturition for a long while, due to the pressure of the tumor,

but the urine examined twenty-seven times previous to the exploratory incision was absolutely normal except for a faint trace of albumin: there was never any sugar present.

The day after the operation, the urine, of specific gravity 1.020, besides containing a trace of albumin, showed a *large amount* of sugar (the exact percentage not given), tested for by the fermentation and Fehling's tests.

The next day, however, the sugar had entirely disappeared, nor was ever a trace of it again found during the patient's convalescence, which was slow but uneventful, the temperature never rising above 100° F.

The other case was a young woman with an unimportant previous history except that she had always been very nervous, and on examination she was found to be of an extremely neurotic temperament. The operation performed was the suspension of a retroflexed uterus and the repair of a relaxed vaginal outlet.

The urine, examined on the day previous to the operation, was found to be absolutely normal, while in the urine voided directly after the operation, 0.8 per cent of sugar was found (tested for by the Fehling's and fermentation tests); no trace of sugar was subsequently found in the urine.

None of these three patients gave any history to suggest that a glycosuria might have been present previously, as polyuria, eczema of the genitals, etc.

The exact cause of the transitory glycosuria in these three cases seems to have been, undoubtedly, the inhalation of the ether, *i. e.*, a toxicogenic glycosuria, while certainly in the last two cases the highly nervous character of the patients may have aided materially as a contributory cause, *i. e.*, there was probably a neurogenic as well as a toxicogenic factor.

When we consider, on the one hand, the enormous number of patients that undergo anesthesia, and, on the other, how many of these are nervous, neurotic and hysterical individuals, in all of whom the thought of operation would be associated with the most intense emotions, it would seem that this condition should not be so extremely rare, and probably a careful urinary examination made after every operation would result, in some cases, in the discovery of a post-operative glycosuria.

### III. MALINGERING MELITURIA.

The third urinary anomaly I wish to report is one which, for want of a better name, I have called "malingering melituria."

The case was admitted to the private ward with the diagnosis of diabetes, made by the physician attending her at her home. The patient was a young girl of extremely neurotic temperament: in fact she had had several attacks of what was probably hystero-epilepsy, the patient apparently becoming unconscious and assuming remarkable poses.

In many respects she did not have the usual symptoms of diabetes, but the urine seemed characteristic; between 4,000 and 7,000 ccm. of a pale urine of a specific gravity between 1.030 and 1.050 being passed during the twenty-four hours.

The urine showed sugar by the Fehling's reaction, although the reaction did not coincide at all with the quantity one would have supposed to be present from the high specific gravity: with phenylhydrazin but few crystals of phenyl-

glucosazon were obtained, while the quantitative determinations made by the polariscope and the fermentation tube differed markedly; by the latter test the gas was formed extremely slowly, but, after standing a considerable length of time, the amount of carbon dioxide formed showed that there was between one per cent and two per cent of sugar present.

On other occasions in which the urine was examined, the phenylhydrazin and Fehling's tests were negative; by the fermentation test gas-bubbles were formed extremely slowly, while the polariscopic test was positive as before.

The urinary condition was such as to make one suppose that the variety of sugar present was not glucose, at least except for an occasional trace, and the absence of phenyl-maltosazon crystals with phenylhydrazin and the dextro-rotatory polariscopic reaction showed that it was neither maltose nor levulose respectively.

It was therefore thought probable that the sugar present might be the ordinary cane-sugar,  $C_{12}H_{22}O_{11}$ , with occasional traces of glucose mixed with it (due either to a slow inversion in the acid urine, or to the commercial introduction of small quantities of glucose). To determine this definitely, chemically, before attempting to discover its source, the following experiments were performed: The urine was concentrated and boiled with dilute hydrochloric acid for from twenty to forty minutes, when the resulting fluid, after being neutralized with bicarbonate of soda, gave the following reactions: By Fehling's test the reaction was extremely marked and instantaneous, differing in this respect from the much slower and less characteristic reaction or the complete absence of reaction noted before; by the phenylhydrazin test the precipitation of the phenylglucosazon crystals was profuse; by the polariscopic test on the other hand, the plane of polarization was turned slightly to the left; while in the fermentation tube the gas-formation was much more rapid than before and the reaction was more marked than with the original specimen.

All these tests showed conclusively that the sugar present was cane-sugar, the reactions just given depending, of course, upon the fact that cane-sugar when boiled with acids is converted into a mixture of glucose and levulose (one dextro-, the other levo-rotatory), and the reactions given above are exactly those that would occur in such a mixture, while the extreme slowness of fermentation of the original urine is explained by the fact that cane-sugar, in the presence of the yeast-ferment is first converted into glucose and levulose, the former of which then undergoes fermentation. As the girl was extremely hysterical and neurotic, and as the passage of such large quantities of cane-sugar in the urine is practically unknown, it was thought that she herself probably introduced the sugar into the urine.

All sugar was therefore carefully kept off her food-tray, and for a time the sugar entirely disappeared from the urine and the specific gravity dropped to between 1.006 and 1.010, although the polyuria continued.

In a few days, however, the sugar reappeared, although not in such quantities as before; a nurse was then detailed to watch the patient most minutely, when it was found that the patient would slyly remove the lumps of sugar from her tea or coffee and deposit them in the urinary vessel.

When this source was also eliminated, the melituria entirely disappeared, and the patient on being confronted with the evidences of her deception, left the ward in high dudgeon, after absolutely denying what the nurse had plainly seen.

This case, I think is quite unique of its kind, the especially interesting feature, besides the presence of the sugar, being the marked polyuria, a very prevalent urinary condition in very neurotic and hysterical individuals, as well as in diabetics.

In these days when the advertising column of every newspaper is a treatise on diagnosis, and every hillside and vacant lot a manual of therapeutics, it is no wonder that the little and often the distorted knowledge that is so dangerous has proven a fruitful source of hypochondriasis, neurasthenia and malingering among the *οἱ πολλοί*; but so far as I know, this is the first case in which it has brought about a malingering melituria.

The cases in the first and second portions of my article were in the service of Dr. Kelly, and the third in the service of Dr. Osler; both of whom I wish to thank sincerely for allowing me to work up and report these cases of "urinary anomalies."

## DISCUSSION.

DR. FUTCHER.—Dr. Brown's cases of post-operative glycosuria following ether administration, call to mind those cases in which the urine contains copper-reducing substances after the administration of certain drugs. In 1875, von Mering and Minkowski found that, after the administration of chloral hydrate to an individual, the urine contained a substance which had the power of reducing alkaline copper solutions. They found that the substance which gave this reaction was urochloralic acid in combination with glycuronic acid. Since that date it has been discovered that a large number of medicinal substances administered internally, either themselves, or in some modification, combine with glycuronic acid and are excreted in the urine, giving rise to a reduction of copper solutions simulating the reaction of glucose. The more important of these substances are chloroform, morphine, camphor, phenol, resorcin, thymol, menthol and others.

The report of the examination of the urine in Dr. Brown's case indicates, however, that the patient had a transitory glycosuria.

## ACUTE LEUKÆMIA IN CHILDHOOD WITH REPORT OF A CASE.

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The question of the condition of the blood in the anæmias of early life is such an unsettled one, and cases of acute leukæmia in childhood are so rare that every such case is worthy of report in detail. The present case is as follows:

*Male; aged 3 years; anæmia; fever; purpuric rash; blood picture of leukæmia; hemorrhages; convulsions; death; duration about one month.*

J. L., male, aged 3 years, was admitted to the service of Professor Osler, in The Johns Hopkins Hospital on May 11th, 1898. The symptoms to which his parents drew attention, were a slight cough and a peculiar area over the sacrum which had almost a gangrenous appearance. The circumstances connected with his admission to the hospital were rather peculiar. His sister was a patient at the time with a surgical complaint, and he was brought from out of the city to see her. He had some cough and interference with his breathing, probably due to adenoids. For this he was admitted, but at the time it was not thought that he had any serious condition.

*Family history.*—One uncle on the father's side had died of tuberculosis; otherwise the history was negative. There was no history of lues nor anything suggesting it.

*Previous history.*—He was a large healthy child at birth. He was not breast-fed, but brought up on various artificial foods, combinations of milk, etc. For two months after birth he did not thrive, but afterwards did well until two years old, when he had fever for some time, the nature of which was unknown. Chicken-pox was the only disease of infancy that he had had. In February of 1898—three months before admission—he caught cold and had some bronchitis. With this it

was noted that there were numerous ulcers over the mucous membrane of the mouth. Since this attack he had some cough and obstruction to his breathing. He did not snore at night, but frequently woke up complaining of being choked. About the same time a peculiar bruised area was noted over the sacrum, which was slightly tender. This was thought to have been due to injury. The area did not increase in size, and there were no others like it elsewhere. Otherwise the boy had seemed to be perfectly well, with good appetite and digestion.

*Present illness.*—There were no special symptoms of this and only the previous conditions were mentioned. To these his parents had given but slight attention, as the boy was thriving and seemed hearty and strong. It was thought, however, that for a day or two previous to admission he had been more easily tired than ordinarily and was rather peevish. He had also complained of some slight pains in the neighborhood of the joints. The boy's father—who was a physician—was positive that until a few days before admission, the patient had been as well as usual and played about with his ordinary vigor.

*Examination* showed a very stout boy, large for his age, but with a generally pale flabby look which was very striking. He was very bright and intelligent and showed a lively interest in his examination. The mouth was kept open, and the breathing was noisy. The tonsils were much enlarged and there were numerous adenoids present. The gums and mucous membranes were very pale. The shape of the thorax was normal. There were no rickety nodules. The percussion



note was clear throughout. The breath sounds were everywhere harsh and accompanied by numerous sibilant and sonorous râles. No tubular breathing was heard. The heart sounds were clear and of normal relative intensity. The abdomen was full and prominent. The edge of the liver was felt about 3 cm. below the costal margin. The spleen was palpable and hard, although not enlarged beyond the costal margin. There was no tenderness over the abdomen. There was no glandular enlargement. No œdema or signs of rickets were present. Over the sacrum was an area about 5 cm. in diameter, dark purple in color and with a bruised, almost gangrenous look. It felt indurated, was slightly tender and was not adherent to deeper structures. No fluctuation could be made out.

The patient remained in the hospital until May 24th, during which time his general condition was as follows:

May 15th. Frequent coughing and constant mouth breathing. His appetite was good and he took his food well.

May 18th. The general condition was worse. There were great irritability and restlessness. At times complaint was made of pains in the legs. A small petechial rash appeared on the legs. It was most marked about the knees.

May 20th. He was very fretful and could only be got to take nourishment with difficulty. At times there were severe paroxysms of coughing. There were periods when he became collapsed with great pallor and a very feeble pulse. The purpuric rash persisted. There were many coarse râles everywhere over the chest. The liver and spleen were as before. No enlarged glands were felt.

May 22d. The patient was much weaker. There was no pain.

May 24th. The condition was worse. He was very weak and took but little nourishment. In view of his grave condition his parents decided to take him home to Indianapolis. It was learned that he stood the journey well and seemed better for a day.

His subsequent history was obtained from Dr. F. B. Wynn, of Indianapolis, to whom I am also indebted for the account of his blood examination. Dr. Wynn writes as to his condition: "The temperature was from 99° to 100°, pulse 140-160 and very weak, respirations 40-50 with considerable dyspnoea, petechial hæmorrhages, several attacks of epistaxis, and on two days nausea and vomiting." Death occurred on May 30th with convulsions which were thought to be due to cerebral hæmorrhage. There was no autopsy.

While in the hospital, his temperature was elevated, usually to 100° and 100.5°. On May 21st it rose to 103.3° falling gradually to 99° on the morning of the 24th. The pulse varied from 120 to 160, and the respirations were usually about 40. Dyspnoea was most marked after the attacks of coughing. He did not lose any weight while in the hospital. The urine had a specific gravity of 1.015 to 1.017. The reaction was acid and there was neither albumin nor sugar present. The diazo reaction was not given. Microscopically urates and uric acid were found.

*Blood.*—The first examination after admission was on May 12th. The hæmoglobin was 35 per cent (v. Fleischl), the red corpuscles 1,680,000, and the white cells 26,000 per cmm.

(a ratio of 65 to 1). A differential count of 1000 leucocytes in specimens stained with Ehrlich's triple stain showed:

Polymorphonuclears . . .	13.3 per cent.
Lymphocytes, Small, 41.5 } 86.5 do.	
do. Large, 45. }	
Large mononuclears . . .	.2 do.

The red cells did not show any special variation from the normal in either shape or size, and but slight polychromatophilia. No nucleated red cells were seen in counting 2000 leucocytes nor in careful additional search. The lymphocytes showed all variations in size from the smallest up to some which were fully 15 microns in diameter. So many cells were on the border line that the division into small and large is only approximate. The depth of nuclear staining varied much in cells of the same size but the general staining was pale. This was more marked in the larger forms; still, there were but few small lymphocytes with a typical deeply staining nucleus. Cells with nicked or divided nuclei were very rare. The protoplasm about the nucleus was unstained in the majority of the larger forms. One myelocyte was seen. In this, as in the later specimens, there was a marked tendency for the lymphocytes to disintegrate and appear in the stained specimen as shapeless blotches with a pale blue stain. The polynuclear cells in the same specimen would be quite normal. It was found that by making the specimen rather thick, and drawing the covers apart as rapidly as possible, this disintegration could be prevented. Both the small and large lymphocytes showed the tendency to break up.

May 15th. The differential count of 1000 leucocytes showed—

Polymorphonuclears . . .	4.4 per cent.
Lymphocytes, small, 78.9 } 95.6 do.	
large, 16.7 }	

The general characters of the cells were much as on May 12th. There were still all variations in size between the largest and smallest lymphocytes. No nucleated red cells or myelocytes were found.

May 19th. The hæmoglobin was 32 per cent, red corpuscles 1,760,000, and white cells 60,800 per cmm. (a ratio of 29 to 1). The differential count of 1000 leucocytes gave:

Polymorphonuclears . . .	.4 per cent.
Lymphocytes, small, 96.6 } 99.2 do.	
large, 2.6 }	
Large mononuclears, . . .	.3 do.
Eosinophiles, . . .	.1 do.

The red cells were much the same. No nucleated red cells were found in counting 2000 leucocytes, and in additional search. The lymphocytes were much smaller on the average, and many of them were of the typical small type. No myelocytes were seen.

May 24th. The hæmoglobin and red cells were practically the same as on the 19th, but the white corpuscles had fallen to 21,800 per cmm. (a ratio of 84 to 1). The differential count of 1000 leucocytes showed:

Polymorphonuclears, . . . . .	.9 per cent.
Lymphocytes, small, 89.2 } .98.6 do.	
large, 9.4 }	
Large mononuclears, . . . . .	.4 do.
Eosinophiles, . . . . .	.1 do.

The general characters of the cells were as before, but the red cells showed somewhat greater variation in staining. No nucleated red cells or myelocytes were seen.

Dr. Wynn very kindly sent me his count taken a few days later in Indianapolis. The hæmoglobin was 30 per cent (Gowers), red corpuscles 1,800,000, and white 36,000 per cmm.

In considering this case a striking feature is the rapid course. The patient was admitted to the hospital almost accidentally—if one may so term it—on May 11th, and beyond the presence of enlarged tonsils and adenoids he seemed, on superficial examination, to be in ordinary good health. Had it not been for the results of the blood examination, no suspicion of leukæmia would have been entertained. There were no symptoms pointing to acute disease, and his father was sure as to his having been in his normal condition up to a few days before. From the time of admission to the hospital until death was less than three weeks. Including the few days of malaise previously the whole course was not over four weeks. Even when the first blood examination was made, the possibility of the case being one of extreme lymphatism was considered, although the high percentage of lymphocytes (86.5) suggested leukæmia. In his condition any attempt to remove the adenoids and enlarged tonsils was thought unadvisable, even though they caused considerable obstruction. About May 18th the general condition changed and the symptoms were more severe. The blood showed 99.2 per cent of lymphocytes and the hæmorrhagic rash had appeared. The temperature ranged higher and from this to the time of discharge the downward course was rapid. Death, as already noted, occurred on May 30th.

In regard to the blood condition a relatively high proportion of the hæmoglobin to the red corpuscles is seen. The color index on the first examination was slightly over 1, falling a little below it subsequently. A high-color index, while usually characteristic of pernicious anæmia, occurs not infrequently in other blood conditions. In a recent case of lymphatic leukemia in this hospital the color index was always about 1 during observations extending over a period of two months. In two recent cases of splenic anæmia the same ratio was observed. It will be noted that there was practically no diminution in the number of red cells during the course of the disease. In the stained specimens they showed but little variation from the normal throughout. Variations in the staining were rather more marked. No nucleated red cells were found at any time, although special search was made for them. In all the specimens the same difficulty was found in obtaining satisfactory slides. Unless the covers were drawn apart very rapidly, the majority of the lymphocytes were irregular masses without any definite outline. They took the stain exactly as the nuclei in the better specimens. This tendency to disintegration may be a feature of the lymphocytes in acute cases. So far as known there are

not sufficient observations to speak with certainty on this point. The staining of the nuclei of the lymphocytes showed great variation, although the prevailing stain was a pale one, and this was most marked in the larger forms. The lymphocytes showed increase both absolutely and relatively. The polymorphonuclears showed an absolute reduction. On admission they were 3400 per cmm., but fell later to 240 and 180 per cmm. The eosinophiles were absent in the earlier counts, and 60 and 21 per cmm. were found in the later ones.

Leukæmia is a relatively rare disease in the first decade. Cassel<sup>1</sup> states that among 3000 autopsies in Friedrichshain there were only two instances of leukæmia below the age of ten years. Considering acute leukæmia, however, there seems ground for thinking that it occurs in a somewhat larger proportion. Theodor<sup>2</sup> collected 45 cases of acute leukæmia of which 6 were in the first decade. There were 5 between the ages of 10 and 15 years. Fussell and Taylor<sup>3</sup> have published a series of 56 cases, among which 9 were in this period. Morse<sup>4</sup> in reporting a case in 1898 collected 7 from the literature. There is doubt expressed as to cases reported some years ago, but apparently 13 previously reported cases may be accepted. A recent case in an infant reported by Pollmann<sup>5</sup> is not included, as the condition appears to have been considered congenital. Bloch and Hirschfeld<sup>6</sup> report a case in a boy aged eight months, which was probably acute, but the exact duration was not known. The present case is the fourth to be reported within a year. The previous cases are as follows:

I. Keating<sup>7</sup>. Female, aged 4½ years; epistaxis, fever, hæmorrhagic rash, cervical glands and spleen enlarged. The blood was examined by Dr. Osler. The red cells were normal, no nucleated cells being seen. The whites were very numerous, there being 50 or 60 in one field. They were largely lymphocytes. Duration 9 weeks; type probably lymphatic.

II. Wadham<sup>8</sup>. Male, aged 5 years; no hæmorrhages, slight fever, cervical glands enlarged, abdominal pain and distention. The type can not be decided from the description given. Duration 8 weeks. Autopsy.

III. Guttman<sup>9</sup>. Male, aged 10 years; a previous history of enlarged tonsils and adenoids, hæmorrhages, hæmorrhagic rash, no fever, hemiplegia, priapism, spleen and liver enlarged. The blood showed whites to reds as 1 to 1.4. Type was probably lymphatic. Duration 4½ days. At autopsy the thymus was found much enlarged.

IV. Eichborst<sup>10</sup>. Male, aged 8 years; onset sudden with precordial pain, hæmorrhages, fever, enlarged spleen and liver; no swelling of the lymph-glands. The blood showed 88,000 whites. No nucleated reds were seen. Duration 2 weeks. Autopsy. Lymphatic in type.

V. Müller<sup>11</sup>. Male, aged 4 years; hæmorrhages, ulceration of throat and only the cervical glands enlarged, liver and spleen enlarged, fever. The blood showed 109,000 whites of which 97 per cent were mononuclear, with an acute staphylococcus infection. Shortly before death the leucocytes fell to 6800. Duration 5 weeks. Lymphatic in type. Autopsy.

VI. Müller<sup>11</sup>. Male, aged 4 years: hæmorrhages, hæmorrhagic rash, fever, liver and spleen enlarged. The blood showed 209,000 white cells of which 98 per cent were mononuclear. Duration 4 weeks. Type lymphatic. No autopsy.

VII. Goldschmidt<sup>12</sup>. Male, aged 2½ years: cervical glands enlarged, liver and spleen enlarged, fever, nephritis. Blood picture of leukæmia. Nucleated red cells present. Duration 8 weeks. Autopsy. Lymphatic in type.

VIII. Theodor<sup>13</sup>. Male, aged 4 years: luetic family history, hæmorrhages, cervical glands enlarged, spleen enlarged, liver not; no fever. The white cells were to the reds as 1 to 9. Nucleated red cells were present. Duration 6 weeks. Lymphatic in type. No autopsy.

IX. Cabot<sup>14</sup>. Infant; lymphocytes over 98 per cent, duration 6 weeks, lymphatic in type.

X. Morse<sup>15</sup>. Female, aged 3 years; hæmorrhages, enlarged tonsils, liver and spleen enlarged, general glandular enlargement. The duration was not more than 7 weeks, and probably less. The type was lymphatic. No autopsy.

XI. Bradford and Shaw<sup>16</sup>. Male, aged 7 years; hæmorrhages, fever, swelling and ulceration of the mouth, cervical glands enlarged, spleen enlarged, liver not. Duration probably 7 or 8 weeks. Autopsy. Lymphatic type.

XII. Haushalter and Richon<sup>17</sup>. Male, aged 7½ years: hæmorrhagic rash, no fever, glands and spleen enlarged, blood cultures yielded streptococci. Duration 8 weeks. Autopsy. Lymphatic type.

XIII. Bradley<sup>18</sup>. Male, aged 8 years; hæmorrhages, hæmorrhagic rash, liver and spleen enlarged. The white cells were 85,000, of which 97 per cent were lymphocytes. There were a few nucleated red cells present (personal communication from Dr. Bradley). Duration 7 weeks. No autopsy. Lymphatic type.

It is of interest to compare the symptoms in this series of cases. As in case IX only the blood features and duration are known, it is not considered in the figures given for various other symptoms.

*Family history.*—There is nothing of any importance under this heading. In only one case was there a luetic history, and two had a tuberculous family history.

*Previous history.*—Various infections are noted in the previous histories of the cases. One had had meningitis, one measles, one suppurating cervical glands, and three had suffered from some affection of the tonsils. This last is of some importance in connection with the number of instances in which the disease was accompanied by acute tonsillitis.

*Sex.*—A large proportion of the cases were in males, namely 11 out of 13. This is true of acute leukæmia at all ages. In the series of Fussell and Taylor, among 55 acute cases where the sex was known, 33 were males. The same is found in leukæmia generally in childhood. Thus, Birch-Hirschfeld, among 39 cases below the age of 15 years, found 25 males and 14 females. This applies to cases from the earliest years.

*Onset.*—This was sudden in many of the cases as might be expected from the rapid course. In one case, No. VIII, the first symptom was hæmorrhage following a fall from a horse. In four cases hæmorrhage was the first prominent symptom.

*Hæmorrhages.*—These occurred in 10 cases. The bleeding was from the nose, mouth, stomach, bowels and kidney. In no case did the bleeding seem to have been sufficient to cause death directly. A hæmorrhagic rash was present in 10 cases, of which 9 had also bleeding from a surface.

*Fever.*—This was noted in 8 cases, its absence in 4, and in 1 there was no note. The temperature was usually not extremely high. The highest was in No. XI, where it rose to 105.4°. In this case blood cultures taken at this time were negative.

*Glandular Enlargement.*—General enlargement was noted in 4 cases, enlarged cervical glands only in 5 cases, no enlargement in 2, and no note in 2 regarding it. In the cases with enlargement of the cervical glands only, this was usually associated with local throat or mouth conditions such as enlarged tonsils, adenoids or ulceration.

*Spleen.*—This was enlarged in all the cases. The degree was not great, the edge usually being 3 to 4 cm. below the costal margin.

*Liver.*—There was enlargement in 8 cases, none in 3, and in 2 the condition was not noted. In no case was the enlargement extreme.

*Miscellaneous Symptoms.*—Pains in the joints and bones were noted, hemiplegia, priapism, etc., but none in any large proportion of the series.

*Blood.*—There was marked anæmia in all the cases in which blood examinations were made. Among the eight cases in which the corpuscles were counted the highest count was in No. VI, viz., 2,350,000 and the lowest of 1,000,000 in No. IV. The percentage of hæmoglobin varied from 40 in No. V to 18 in No. II. The degree of anæmia in these acute cases is striking. It suggests the possibility of the development of the disease in children already anæmic. The red corpuscles did not show any rapid fall while the cases were under observation. If such low counts were suddenly brought about by the disease, it would seem probable that the rapid fall would continue with the advance of the other symptoms. If the onset of the disease were attended with such rapid blood destruction, why not the terminal stages? An explanation may be that these children had been suffering from leukæmia in a more chronic form for some time and that what we consider the whole course was only an acute exacerbation at the termination. The histories of these cases and the consideration of the marked general features do not support this view. The question is an interesting one, and may be answered when cases have been observed with blood counts taken prior to the onset of any symptoms.

The high-color index in the present case has already been commented on. A color index over 1 was shown in 4 cases of the series, Nos. IV, V, XIII, XIV. When the color index was below one, as in three cases, Nos. VI, X, XII, it was only about .5. This relation of the hæmoglobin to the red cells divides the cases into one class with the blood of a pernicious anæmia type, and into a second with the characters of a secondary anæmia. As already stated a similar point has been noted in a series of cases of splenic anæmia. So far as can be gathered from the descriptions given, no difference was observed in the shape and size of the red cells in these two groups. In spite of the severe anæmia the red corpuscles as a



rule showed little variation from the normal in their characteristics. This may be due to the acuteness of the condition as in a case of pernicious anæmia at present under observation in which the symptoms developed with great suddenness. It was fully two months after the onset before the red cells showed any special variation in size, shape or staining. In 10 cases of this series it was noted that the red cells showed no marked changes from normal in their general characters. In the remaining 3 cases there was no note on this point. The occurrence of nucleated red corpuscles is an interesting question. The statement is made by some writers that cases of leukæmia in children show more abundant nucleated red corpuscles and that megaloblasts are usually equal in number to normoblasts. The cases of this series do not seem to support the view that nucleated red cells are common in acute leukæmia in childhood. Thus among 11 cases in which full descriptions are given, no nucleated red cells were found in 7, and in the 4 cases where they were found the numbers do not seem to have been large. In only one case, No. VIII, was the occurrence of megaloblasts noted. In this instance their number increased while the patient was under observation.

*White corpuscles.*—The number of the leucocytes shows wide variation. There are counts in 8 cases, the highest being 209,000 in No. VI, and the lowest 21,000 in the present case. The characteristics of the white corpuscles are much the same in all the cases. In some only a general account is given but sufficient to recognize the prevailing type of cell. In all there is an absolute and relative increase in the mononuclear elements. The proportion of large to small cells varies in the different cases. There does not appear to be any relation between the varying proportions of large and small forms and the relative acuteness of the disease. The mononuclears in all the described cases showed great variation in their staining. The largest absolute number of mononuclear cells was in No. VI, where they numbered 204,800 per cmm. The absolute number of the polymorphonuclear leucocytes was about normal in most of the cases. The highest number per cmm. was in No. XI, where they were about 15,000 on one occasion and 8800 on another. The lowest number was in the present case, where on admission they were 5400 per cmm., falling later to 240 and 180. Myelocytes were rarely seen and were only noted as of very occasional occurrence.

*Type of Leukæmia.*—This is apparently lymphatic in 13 cases, and in the remaining case no note regarding the blood is given. This is in accordance with the acute course of lymphatic leukæmia generally as compared with the splenomyelogenous type. There are instances of the latter variety in children.

*Duration.*—The period of nine weeks has been generally accepted as the limit of time within which a case should be considered acute. While the general features of the case should also be considered in classing a case as acute, still it will be found that nearly all cases with acute features terminate in this time. Müller,<sup>11</sup> in reporting the two cases noted before, has also described a case with a duration of 13 weeks, which, in its general features, might be termed acute. The duration in 4 cases of this series was less than one month, and in 10 was between four and nine weeks.

*General features.*—These cases show some agreement in their features beyond the acute course. The disease occurs usually in a male with no special feature in his family or previous history except perhaps a history of throat trouble. This was marked in some instances and suggests possibly something of a causal relationship. In one, No. XII, emphasis is laid on the presence of carious teeth. Possibly, if this condition had been more often looked for, it might have assumed more importance as a possible causal source of infection. Hunter<sup>12</sup> has recently raised the question of a possible association between foci of infection in the mouth—such as carious teeth—and pernicious anæmia, considered as a chronic infective disease. A possible relationship to the so-called "Lymphatic Constitution" must also be considered. This has been discussed by Ewing<sup>13</sup> who considers that there is no direct indication of connection between that condition and leukæmia. That children with the lymphatic constitution are more apt to develop leukæmia we can not say. One of the series, No. III, showed a much enlarged thymus at autopsy.

The onset is usually with moderate suddenness; fever is present in a majority of the cases with hæmorrhages and a hæmorrhagic rash. General glandular enlargement is found in less than half of the cases; in more the cervical glands alone show enlargement. The spleen was enlarged in every case where there are notes of an examination and the liver also in more than half of the series. In all, the anæmia is a striking feature, and the symptoms of the disease may be summed up as a severe anæmia with frequent multiple hæmorrhages, fever, enlargement of the spleen and frequently of the liver. In some cases general glandular enlargement, but in others only of the cervical glands, enlarged tonsils, ulceration of the mouth, pains in the bones, etc., are present. With these is a downward course to a rapidly fatal termination. Guinon and Jolly<sup>14</sup> in discussing the subject divide the cases into three classes:

1. Typical forms: swollen glands; anæmia; terminal hæmorrhages.
2. Hæmorrhagic form: features of an infectious purpura.
3. Pseudoscorbutic: lesions of the mouth, gums and tonsils predominate.

*Diagnosis.*—This can only be made with certainty through the examination of the blood. In nearly all the cases emphasis is laid on the striking anæmia. This with the severe general symptoms and the occurrence of hæmorrhages should suggest a blood examination. Probably the conditions with which it is most apt to be confounded are: (1) an acute infection with specially marked throat symptoms, and (2) a hæmorrhagic purpura. Bradford in referring to his cases has laid emphasis on the probability of considering an acute leukæmia to be merely an infection unless a blood examination be made. Probably, with more frequent routine work on the examination of the blood, cases will be found more often.

*Treatment.*—This can only be symptomatic with our present knowledge. In no case does any treatment appear to have been of any service.

In conclusion, emphasis may be laid on the necessity of careful study of the anæmias of early life. The subject at

present is in a rather chaotic state, and only through careful blood examinations can we hope to have the lines drawn more satisfactorily.

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## PERSONAL EXPERIENCE IN OPERATIONS FOR STONE IN THE BLADDER.\*

BY A. T. CABOT, A. M., M. D.

Not many years ago, a leading surgeon of the West, going through the Massachusetts General Hospital, pointed to the Bigelow instruments and asserted that in a few years litholapaxy would be an operation of the past.

I would ask you to contrast with this opinion the experience and practice of English surgeons in India. Those men, who see more stones in a year than many of us do in a lifetime, are earnest and enthusiastic advocates of litholapaxy. Indeed, it was an Indian surgeon who extended the scope of the operation to the treatment of children.

Which of these opinions is most in accord with the facts? Is litholapaxy being superseded by other methods of stone-removal and becoming obsolete or not? Ought it to be so superseded? These are the questions that I wish to discuss with you in the light of what experience I have had.

In considering the comparative value of these operations, we have to take account of the death-rate which accompanies each, of the injury to important structures which each involves, and of the liability to a recurrence of stone-formation which follows each.

A statistical study of these questions from cases reported by other operators is difficult and of little value. Many surgeons use litholapaxy for their easy cases, where the stone is small, and cut for their larger stones, in which a longer duration and severity of the disease has presumably led to serious secondary changes in the urinary organs. Such a practice

would give litholapaxy an unfair showing over the operations resorted to in the more serious cases.

Again, in many of the cases of suprapubic incision for stone, the operator removes a portion of the prostate or digs the stone out of a pocket, so that the operation ceases to be a simple lithotomy.

When we come to an examination of the question of injury to the parts about the neck of the bladder, it is often impossible for the surgeon who operates to follow his patient in after life and ascertain the extent and remote consequences of such injury. Cases occasionally come to the notice of all of us in which an incision made in childhood has led to impotency, not discovered until after puberty was established, or even much later. I have met with at least two cases in which a perineal lithotomy has been followed many years later by a narrowing of the urethra sufficiently close to cause symptoms of stricture, and in one of these a pachydermia vesicæ, and, finally, a carcinomatous condition of the bladder, developed.

Lastly, in judging of the frequency of stone-recurrence, the difficulty is even greater; and one is constantly compelled to revise his own statistics, as cases supposedly cured reappear with a return of symptoms. How often this recurrence occurs in cases reported by others, it is difficult to say; but, judging from my own experience, it must happen more often than published statistics would lead one to suppose.

For these reasons I propose to depend, as far as possible, on my own experience for the facts from which I draw the conclusions I shall present. I shall endeavor to give this experi-

\* Read at the meeting of The Johns Hopkins Hospital, April 2d, 1900.

ence in a sufficiently explicit manner to enable others to judge how far my deductions are supported by reliable observation.

The stones I have met with in my practice have been, as a rule, secondary to enlargement of the prostate. Many of them, in fact the majority, have been phosphatic stones, dependent upon the cystitis set up by the enlargement of the prostate. Even the uric-acid stones which have occurred in these cases have usually been in part due to the incomplete emptying of the bladder, owing to the obstruction.

The average age of these patients has been somewhat over sixty years. The material, therefore, from which I have derived my experience, has been as unfavorable to success in stone-treatment as is possible; for most of the operations have necessarily been done in bladders already diseased, often too, in cases where the kidneys were more or less affected.

Litholapaxy has been the operation of choice in all of my cases, irrespective of the size of the stone or the condition of the patient, except in a few instances when, for some reason, it could not be used or when some other condition compelled a cutting operation and the removal of the stone was merely an incident in this. Thus, in operations for stone I have done litholapaxy 122 times, suprapubic lithotomy 12 times, and perineal lithotomy once.

The suprapubic operations were selected in two cases because the lithotrite would not enter the bladder without an undue exercise of force. In six cases the operation was primarily a prostatectomy, and in one case the coexistence of a myoma of the bladder-wall compelled us to make the suprapubic incision. In two cases the stones were sacculated and could not be reached by the lithotrite. In one case the stone was so large that the lithotrite, when grasping it, would not lock.

I find that out of the one hundred and twenty-two litholapaxies six patients have died within a comparatively short time after the operation. In order that you may judge of the degree in which the operation was responsible for the deaths, I will briefly report these cases.

The first death occurred in a man sixty-nine years of age, upon whom I operated in 1885. The patient was feeble and had a weak pulse. The condition of the urine, however, was reasonably good, showing nothing beyond alkaline fermentation, and it was passed in good amount. The patient, however, had a troublesome cough with profuse purulent expectoration. The stone was small and soft, weighing only 98 grains and the operation was in no way difficult. The patient was wholly relieved of his urinary symptoms by the removal of the stone, the urine became acid, and almost wholly cleared of pus. In the meantime, however, his cough became much worse. On the fourth day after the operation he began to have considerable dyspnoea, and presently an examination of the lungs revealed the presence of pneumonia, secondary to the bronchitis which had existed previous to the operation. He died on the tenth day following the operation.

The second patient was an old man who had complete obstruction of the prostate so that for some time the urine had been drawn by suprapubic aspiration. The aspirating needle touched a stone and I was then called to the patient. At the time that I saw him the urine was suppressed, so that the contents of the bladder at the operation consisted almost

wholly of stringy mucous. The operation was done as a desperate effort, without much hope of its success. A large oxalate-of-lime stone was crushed and pumped out. The kidneys never resumed their function after the operation and the patient died about twenty-four hours later.

The third patient was a broken down man of sixty years who had a chronic bronchitis, with a feeble heart. He entered the Massachusetts General Hospital on account of extreme pain in the bladder and frequency of urination. A stone had previously been touched before he was sent in. The condition of his lungs and heart was so wretched that he was kept in the Hospital two months while everything possible was done to improve his condition and get him to the point of bearing the operation. The urinary difficulty and pain, however, were so excessive that he got little sleep and did not regain any strength. A quick litholapaxy was, therefore, finally done under ether. The operation did not take long and was not especially difficult. The patient, however, developed a great increase of difficulty of breathing immediately following it and died three days after the operation.

The fourth case was that of a woman sixty-two years of age. A hard stone weighing a little over an ounce was removed by litholapaxy and at the same time, some glands in the neck, which were extensively tuberculous, were curetted. The patient did very well for a time. The temperature fell to normal and recovery seemed assured, when she gradually began to fail and died six weeks after the operation, death being due to the tuberculosis and not in any way to the operation on the bladder.

Case 5 was a man eighty-four years of age who had suffered for a long time from urinary symptoms, believed to be due to enlargement of the prostate. A catheter, which was tied in his bladder was so worn upon one side that it became evident that there must be a stone there pressing upon it. I etherized and examined him. There was a large stone, in fact I thought there were several stones, in the bladder, which were crushed and pumped out. This operation relieved his pain in great measure, but for three weeks following the operation the temperature was irregular and the general condition of the patient rather unsatisfactory. This was ascribed to pyelitis and possibly pyelonephritis. Finally, on the twentieth day after the operation, the temperature fell to normal and remained so until the twenty-seventh day. The patient was now suddenly taken with severe dyspnoea with symptoms pointing to the chest, and quickly died. An autopsy was not allowed, but it seemed quite clear that the final cause of the death was pulmonary embolism, which came at the time when he was practically recovered from the immediate effects of the operation.

The sixth case was that of a feeble man of seventy who entered the Hospital with a history of having had symptoms of stone for six months. The operation was an easy one and the patient seemed to be reasonably well after it. Death occurred suddenly and unexpectedly on the third day. The autopsy showed a condition of pyelitis and pyelonephritis, although no cause for the suddenness of the death could be discovered.

It would be certainly a contradiction of fact to ascribe the death in the fourth case to the operation.



In Cases 1 and 3, the fatal outcome did not in any way result from the manipulations of the operation, but was probably dependent on the irritation to the lungs of the anæsthetic employed.

Cases 2 and 6 died, in spite of the operation, of the condition of the kidneys which already existed at the time of the litholapaxy.

In Case 5, the pulmonary embolus may have come from the pelvic veins and have been, therefore, an indirect result of the operation. I remember one fact bearing upon this point and that is, that in one case, which subsequently recovered, I saw a phlebitis of one leg following a secondary washing of the bladder, done ten days after a litholapaxy. This shows that the pelvic veins may occasionally become inflamed from the irritation caused by the use of urethral instruments.

If all of these cases, except the one that died of tuberculosis, be counted as deaths from litholapaxy, we have a mortality of 4 per cent.

Every one of the patients who died was in a seriously damaged state before the litholapaxy and the outcome was to be ascribed to an aggravation of antecedent conditions rather than to any damage inflicted by the operation.

As far as this experience goes, then, we have the right to feel that a litholapaxy on a tolerably healthy subject has practically no risk.

Further than this, a study of my cases shows that among them were a number of patients who were passing large quantities of urine of low specific gravity and several that had shown digestive disturbances suggestive of mild uræmic conditions.

Such patients are, according to my experience, very unfavorable subjects for lithotomy or any extensive cutting operation, and yet, with one exception (Case 6 just reported), they did well after litholapaxy.

Could any of the patients who died have had a better chance by any other operation?

I think that possibly this question should be answered in the affirmative, in regard to two of them; for, at the present time, instructed by some excellent work, done here at Johns Hopkins Hospital, should I again have a case of stone in a man suffering from serious bronchitis, I should be inclined to prefer a suprapubic lithotomy, done under cocain anæsthesia, to a litholapaxy.

My friend, Dr. Chismore, of San Francisco, would doubtless in such a case do litholapaxy under cocain anæsthesia; but I have had such difficulty in producing a satisfactory anæsthesia of the prostate and bladder in this way, that I should prefer the quick cutting operation.

#### DIFFICULTIES MET WITH IN THE OPERATION.

I have had two cases, already mentioned, in which the enlarged prostate so resisted the passage of the lithotrite that I was obliged to resort to a suprapubic operation. These are the only instances in which I have had to abandon an attempt at litholapaxy.

A strictured urethra adds little difficulty to the operation. If it yields readily to divulsion, the canal thus enlarged can

be easily traversed by the litholapaxy instruments, and I have done many operations in this way.

When a tight stricture exists in the perineum, urethrotomy may be done and the opening thus made may be utilized for the litholapaxy. A perineal litholapaxy is an easier operation than where the instruments have to traverse the whole length of the urethra. With the patient in the lithotomy position the stone rolls back towards the fundus of the bladder where it is easily reached, and through the distensible deep urethra large instruments can be readily used.

In the whole series of litholapaxies I have had but one serious accident. This was a rupture of the bladder and has been fully reported. I will here only say that the bladder was very intolerant and spasmodic; so much so that I introduced but two ounces of fluid before using my lithotrite. The stone was a very small one, and was caught and crushed at once without any difficulty. During this procedure the water was kept in the bladder by a rubber band around the penis. A constant oozing of fluid through the interstices of the instrument showed how great the pressure in the bladder was. When the tube was introduced it was at once found that the water, which went in without resistance, did not return, and it was, therefore, evident that the bladder had ruptured itself. An immediate laparotomy showed that the rupture was extraperitoneal, and that the effusion was under the peritoneum on the left side of the pelvis. This collection of fluid was drained by an incision similar to that for tying the iliac artery, and a drainage tube was also introduced into the bladder through the perineum. The patient recovered, but always continued to have an excessively irritable bladder.

As it is well known that the bladder has been frequently ruptured when distended in a suprapubic operation and that even the rectum has been similarly damaged by the Peterson's bag, it will be seen that this accident is in no way peculiar to the operation of litholapaxy. In fact, the introduction of fluid in litholapaxy is so constantly under the control of the surgeon's hand that he is able to accurately judge of the degree of distention. It is, therefore, an accident which must occur but rarely, and then only when extremely thin-walled diverticula exist.

The fear that many surgeons have of nipping the bladder-wall with the lithotrite has little, if any grounds.

When the bladder contains a proper amount of fluid, its walls are gently stretched, and it is almost impossible to catch them with the instrument, even if the effort is made to do so. The danger may be wholly avoided by operating in the centre of the base of the bladder. When the heel of the instrument rests at this point, the bladder-walls do not fall into the blades and sufficient space is given for easy manipulation of the instrument without touching them.

#### INJURY DONE BY OPERATIONS.

I have known of no serious or lasting injury following a litholapaxy. The irritation following the operation quickly subsides, and leaves the patient no worse for the operation.

Suprapubic lithotomy avoids important structures, but occasionally leaves an annoying and obstinate fistula. Perineal lithotomy, by which I mean the lateral incision, has the dis-

advantages, already alluded to, of occasional impotency, occasional stricture, and rarely of fistula following it. I have seen instances of all of these sequelae, so that litholapaxy has a decided advantage in the avoidance of injury.

#### RECURRENCE OF STONE.

Among these patients are two instances in which a uric-acid stone has re-formed in consequence of the persistence of the diathesis that led to its original formation. On one of these patients I operated twice, and upon the other three times.

There are nineteen instances in which a phosphatic stone has appeared some months or years after the removal of a primary stone. In two or three instances the primary stone was a uric acid calculus; in all other cases it was phosphatic.

In six of these cases, the previous operation had been done by some other operator.

This recurrence of a phosphatic stone may be due to the persistently alkaline condition of the urine. Several instances of this sort have come to my notice, the most striking of which was a case of multiple calculi in which, within a fortnight of a thorough washing out, the bladder would contain from fifty to one hundred little, separate, well-formed stones. This tendency was finally overcome by frequent pumping out of the calculi, combined with medical treatment directed to making the urine acid.

In two or three cases the recurrence may perhaps be regarded as the result of an incomplete operation, leaving a fragment to serve as a nucleus for a new stone. This accident has usually been avoided by care in washing out the bladder with the evacuator ten days or a fortnight after the litholapaxy. In some cases several washings have been necessary before the bladder was found to be entirely free from calcareous matter.

In one case, of a woman, the projection into the bladder of two stitches put in by two other surgeons, for the closure of the opening made in doing a vaginal lithotomy, led to the repeated recurrence of calculi until the stitches were found and removed.

In two cases sacculated stones which lay concealed in pockets in the vesical wall gave rise to repeated stone-formation in the bladder-cavity. The removal of the stones loose in the bladder was followed in each case by such a cessation of symptoms that the presence of the encapsulated calculus was not suspected, but it was finally found by a cystotomy done for the purpose of discovering the condition to which the recurrence of the stone was due.

Finally, certain local conditions of the bladder-wall favor the formation of stone and lead to constant recurrences until they are removed.

It is notorious that tumors and granulating surfaces within the bladder are prone to be encrusted with salts. The crystallography of stone-formation is interesting in connection with these cases of calcareous deposit on granulating surfaces.

The crystals that exist in the urine do not tend to cohere and form a stone except in the presence of albuminous material. Rainey showed many years ago that the presence of colloid or albuminoid substances in a solution causes crystalline materials to become spheroidal in shape and to coalesce

in rounded form. This is the law of molecular coalescence which has a very decided bearing upon stone-formation in the bladder.

As long as the urine is non-albuminous, crystals of uric acid or oxalate of lime may form in the urinary passages, be washed along and discharged with the urine without forming a stone. But when albumin is present, either in the pus thrown out in consequence of some irritation or in the serum exuding from a granulating surface, we have conditions favorable to "Molecular Coalescence."

It has frequently been urged by advocates of cutting operations that recurrence of stone is especially prone to occur after litholapaxy, owing to incompleteness in the operation. My experience does not coincide with this view; for the cases of recurrence after litholapaxy have, with one or two exceptions, been shown to be due to a general diathesis or to the local conditions described above. The suprapubic operation, too, is far from being exempt from the opprobrium of failure to prevent recurrence of calcareous formation.

I have had one case in which a stone followed a prostatectomy, and in four instances have seen stone-recurrence after suprapubic removal.

But why, it will be asked, should a suprapubic operation, which gives opportunity for the most thorough cleansing of the bladder, leave behind it a tendency to stone formation?

I think the reason for this is that wounds of the vesical wall do not heal immediately by first intention, but are very apt to leave a granulating spot for a greater or less time; and such a surface, as we have seen, is prone to become encrusted with calcareous material and so serve as the nidus for a new stone.

On one or two occasions after a suprapubic operation, I have washed out the bladder with the result of obtaining a little calcareous matter which presumably had been deposited upon such granulating spots.

In 1889, writing upon the Choice of Operation for Stone in the Bladder, I stated as my belief that litholapaxy should be employed except in the presence of one of the following conditions:

1. A very large and hard stone may resist every attempt at crushing, especially if it is tightly grasped by the spasmodically contracted bladder.
2. A stone may have as a nucleus a foreign body, such as a piece of necrosed bone or a bullet, too hard to crush and too large to pass out through a tube.
3. An encysted stone may be out of reach of the lithotrite.
4. False passages may exist, which so interfere with the introduction of instruments that the dangers of the operation are greatly enhanced, and the question of lithotomy is to be entertained.
5. The hip may be ankylosed in a position which interferes with the use of urethral instruments.
6. A stone may be so lodged in the prostatic urethra, that it cannot be pushed back into the bladder where it can be seized by the lithotrite.
7. When the constant recurrence of the stone makes it seem probable that an ulcerated patch exists in the bladder

and is leading to a calcareous deposit, the suprapubic operation is required for the removal of this local condition.

8. In the presence of an obstructing prostate the suprapubic incision will sometimes be advisable, with the object of removing the obstruction. The removal of the stone is merely an incident in this operation.

I have seen no reason, with added experience, to change this opinion except as far as is set forth in this paper, in relation

to cases of coincident bronchitis or other condition making etherization dangerous.

I feel that a mortality of four per cent. in a series of cases averaging sixty years of age, is considerably less than could be expected from suprapubic lithotomy in a similar class of patients, and that the avoidance of fistula and the shortened convalescence add decided advantages to this method of operating.

## SUMMARIES OR TITLES OF PAPERS BY MEMBERS OF THE HOSPITAL AND MEDICAL SCHOOL STAFF APPEARING ELSEWHERE THAN IN THE BULLETIN.

SAMUEL THEOBALD, M. D. A Case of Extensive Detachment of the Retina in a Myopic Eye, in which Complete Recovery followed Rest in Bed and the Administration of Pilocarpin. —*Archives of Ophthalmology*, Vol. XXIX, No. 1, January, 1900.

The treatment was begun within four days of the occurrence of the detachment, and to this fact the successful outcome of the case is, perhaps, in considerable measure, to be attributed. The detachment was so extensive as to preclude an ophthalmoscopic view of the papilla and sight was reduced to ability to detect movements of the hand in the upper and outer portion of the field. Pilocarpin muriate was given by the mouth in increasing daily doses, beginning with gr.  $\frac{1}{4}$  for nineteen days, the maximum dose reached being gr.  $\frac{1}{2}$ . The patient was confined to bed for two weeks, and kept in the hospital for five weeks. The administration of the pilocarpin was followed by five-grain doses of potassium iodid. Within five weeks of the commencement of the treatment the retinal detachment had markedly diminished, and at the end of three months it had entirely disappeared. Gradually improved to  $\frac{20}{1x}$  +. When last seen, fourteen months had elapsed since the reattachment of the retina, and there were no signs of a recurrence of the trouble.

—— Diseases of the Lachrymal Apparatus. —*American Text-Book of Diseases of the Eye, Ear, Nose and Throat*, 1899.

—— Affections of the External Ear. —*American Text-Book of Diseases of the Eye, Ear, Nose and Throat*, 1899.

—— Report of One Hundred Consecutive Cases of Cataract Extraction. *American Journal of Ophthalmology*, Vol. XVI, No. 12, December, 1899, pp. 353-375.

The cases were in no sense selected, but included two eyes which had previously been iridectomized for glaucoma, two in which there was dislocation of the lens of traumatic origin, one in which there was myopia of high grade with detachment of the retina, three in which the cataract was secondary to syphilitic iridochoroiditis, one in which the lens was shrunken and the iris adherent to its capsule, and one myopic eye in which there had occurred previously an attack of iridochoroiditis.

The operations were divided as follows:

Extraction with iridectomy.....	52
Extraction after preliminary iridectomy.....	
(usually accompanied by trituration of lens).....	26
Simple extraction.....	20
Extraction of dislocated lens in capsule.....	2
	100

The results obtained are summarized as follows:

Successes ( $V = \frac{20}{cc.}$ to $\frac{20}{xiii}$ ).....	83
Successes ( $V$ not recorded).....	7
Total Successes.....	90
Partial Successes ( $V = \frac{16}{cc.}$ to $\frac{11}{cc.}$ ).....	4
Partial Successes ( $V$ not recorded).....	2
$V$ not improved (though recovery from operation was smooth).....	2
Losses (from suppuration).....	2
	100

Of the two eyes lost by suppuration, one was a highly myopic eye, in which the operation was completed without accident; the other an eye previously iridectomized for glaucoma, in which the lens capsule was very tough, and the vitreous humor the consistency of water, and in which during the efforts to extract the lens the whole contents of the vitreous chamber escaped, and the eye collapsed. There were five other cases of escape of vitreous, but in these the loss was inconsiderable, and the success of the operation was not impaired. There were seven well-marked cases of iritis. In 27 cases a secondary operation (discission of capsular opacity) was performed (and in three of these a repetition of the discission was required). In no instance was it necessary to perform a secondary iridectomy or iridotomy.

There were no losses among the 26 cases of simple extraction, and, as to visual results, all were successes except one, in which the rather poor sight obtained ( $\frac{15}{cc.}$ ) was due to retinitis hemorrhagica. There were among them, however, 3 cases of prolapse of the iris, and, while only 2 of these were so extensive as to require abscission, they induced, the author tells us, "A lack of confidence in the method, the outcome of which has been an adherence, for some time past, to the modified Graefe extraction—a section throughout in the sclero-corneal juncture, a narrow conjunctival flap, and a small iridectomy made by a single snip with the scissors."

THOMAS R. BROWN, M. D. Cystitis Due to the Typhoid Bacillus Introduced by Catheter in a Patient not Having Typhoid Fever. —*Medical Record*, March 10, 1900.

ARTHUR W. ELTING, M. D. Intermittent Gastric Hypersecretion, with a Report of a Case. —*Boston Medical and Surgical Journal*, March 22, 1900.

HOWARD A. KELLY, M. D. What Precaution Shall We Take to Avoid Leaving Foreign Bodies in the Abdomen after Operations? —*New York Medical Journal*, March 24, 1900.



JOHN G. CLARK, M. D. A Critical Summary of Recent Literature on the Localization, Diagnosis, Prognosis, and Treatment of Gonorrhœa in Women.—*American Journal of the Medical Sciences*, January and April, 1900.

ANDREW H. WHITRIDGE, M. D. Bradycardia with Intermittent Albuminuria.—*Boston Medical and Surgical Journal*, March 29, 1900.

GEORGE BLUMER, M. D. Infectious Character of Tuberculosis and the Prognosis of Incipient Pulmonary Consumption.—*Albany Medical Annals*, April, 1900.

THOMAS McCRAE, M. D. Spleno-Myelogenous Leukæmia with Disappearance of the Spleen Tumor and of the Myelocytes from the Blood.—*British Medical Journal*, March 31, 1900.

## PROCEEDINGS OF SOCIETIES.

### THE JOHNS HOPKINS HOSPITAL MEDICAL SOCIETY.

*Monday, March 5, 1900.*

In the absence of the President, the meeting was called to order by Dr. Hurd.

**The Inheritance of Deafness.**—PROFESSOR W. K. BROOKS.

Some of you know, perhaps, that Professor A. Graham Bell, who is identified in the public mind with the invention of the telephone, has never regarded anything of so-called practical value, like the telephone, as his important scientific work. His life has been devoted to a subject that will appeal to us as more important, but which is not so regarded by the public. He has devoted his life to the amelioration of the condition of the deaf.

Many years ago, Professor Bell's attention was attracted to the fact that deaf people marry much more frequently in this country than they do abroad, the easy conditions of our life enabling them to do so to better advantage here than in foreign countries. These marriages are also increasing very rapidly, and he pointed out that this was accompanied by a very rapid increase in the number of deaf; they are increasing much more rapidly than the population at large. He attributed the tendency of deaf people to marry deaf people to our methods of teaching the deaf. We bring together in the community all the deaf children, as well as the hearing ones, and keep them there during the period when acquaintanceships are formed and they naturally learn a sign-language which separates them from the rest of the community. Believing, then, that this tendency of deaf people to marry deaf people might be due to our method of education, he has advocated teaching the deaf children regular speech in the common schools so that they will not be cut off by language or sympathetic fellowship from their associates, and he has thus made a good many bitter enemies among those whose business is the vested industry of teaching the old sign-language. He has been very successful in his efforts, and this method of teaching has been growing successfully, so that while more deaf children are still taught by the old method than by the new one, the latter is steadily gaining ground. Undoubtedly this will to some extent tend to do away with this tendency of deaf people to marry deaf people.

Professor Bell has endowed the Volta Bureau for the Amelioration of the Condition of the Deaf, an institution with a good equipment, and Professor Fay, one of the prominent educators of the deaf, has made use of it for gathering statistics

concerning the marriages of deaf people, and he has just published a volume of data which contains more statistical information than has ever been published on this subject before.

One interesting result of his study is to show that the influences that cause deaf people to marry deaf people are much deeper seated than Professor Bell supposed. These new statistics show that of the pupils of the asylums who marry, some two-thirds marry deaf persons. Of the deaf persons taught regular speech by the new method who have married, two-thirds have married deaf persons. Of the deaf persons who have been to no institution and who have married, two-thirds have married deaf persons. The classes from which these statistics were taken were not of the same size, it is true, but they indicate that there is some psychological influence at work aside from that referred to by Dr. Bell. This report, however, accomplishes another purpose so successfully that it enables us to control the inheritance of deafness by giving deaf persons who contemplate marriage advice that is scientific, and Professor Fay can now advise them how to marry without the danger of transmission of deafness.

The book contains some 600 or 700 pages of statistics and percentages, and some three months ago I had them well in mind, but my mind is very leaky for figures, and I find the percentages are nearly all gone. I cannot, I fear, present them properly now and you must take such figures as I give with a grain of salt, though they will be, I think, substantially accurate. To show how much need there is for care in handling statistics, I may be allowed to tell an anecdote. I published, a little while ago, a review of this very book, and said that it contained a record of 5000 deaf persons who had married. I received a letter from the author saying I was wrong—that the book contained a record of 5000 marriages of deaf persons in which 8000 deaf persons were concerned.

This study, then, of 8000 deaf persons who have married, shows, in the first place, that deaf people are very much more likely to have deaf children than are hearing people, although they are much more likely to have hearing children than deaf children. Taking deaf people on the average, those who marry must expect to have one deaf child if they have eleven children, so that there are ten chances of a hearing child to one of a deaf child, while normally hearing people need not expect one deaf child in ten thousand children. Of course, this one may be the first or it may be the last of the ten thousand children, and the deaf child may be an only child, while the 9999 may be in other families. The liability to deaf children is not equally great with all deaf persons, the character of the

parental deafness having a great deal to do with it. Some deaf persons who have married deaf persons having large families with no deaf children, while all the children in others were deaf children.

Deaf persons are popularly divided into the congenitally deaf and the adventitiously deaf, the first never having shown any evidence of hearing, the second class having heard, but having lost the ability to hear. Now, when classified in this way there is a probability of transmission in, I think, 30 per cent for the congenital group, and less than 5 per cent for the second group. If it were possible to draw this line with rigorous exactness, if it admitted of any scientific restriction, it would always be highly imprudent for the congenitally deaf to marry, while much less hazardous for the adventitious deaf to do so; but this line cannot be drawn with exactness. Deafness is never discovered until the child has reached the age when normal children begin to talk. Then, too, many people who lose their hearing through disease, after having once heard, have deaf relatives, which shows that they had a susceptibility to deafness, that it was not purely adventitious, and that possibly from the scientific side it might really have been a congenital deafness. As a matter of fact most persons reported as congenitally deaf can only be said to be supposed to be congenitally deaf, and *vice versa*. You cannot divide the two classes on that line.

It has been known for a long time that deaf persons frequently have relatives who have deaf children; and Professor Fay has divided these 5000 marriages into two groups, those concerning people known to have deaf relatives, and those not known to have had such. Here the result is remarkable indeed, for deaf persons who have deaf relatives will have nearly 40 per cent of deaf children, while deaf persons without deaf relatives, who marry, will have only 1.2 per cent of deaf children. In a country like this, where very few persons know all their relatives, and where it is possible that it may be very difficult to trace collateral branches thoroughly, perhaps some of these deaf people that are reported to have had no deaf relatives simply had no known deaf relatives, and Professor Fay has stated that in some of his cases this was found later to have been the case. He thinks that where they have no deaf relatives there is really little more danger of deaf children than happens to normal people; that is, deaf persons without deaf relatives may marry with as much safety as ordinary people. Even there we cannot be sure, for deaf persons may have no deaf relatives, because they are not yet born, and deaf persons may have unborn brothers or cousins who will be deaf. As deaf people do not marry, however, until mature, as a rule, that danger is very slight, and it is pretty safe to advise them that they may marry provided they do not marry a mate with deaf relatives. On the other hand, deaf persons with deaf relatives should be advised not to marry under any consideration.

It did not fall within the province of Professor Fay to consider, statistically, the hearing persons who have married; but he shows clearly that a hearing person with deaf relatives is just as likely to transmit deafness as is a deaf person; and it is a little more unsafe for a hearing person with deaf relatives to marry than for a deaf person without deaf relatives; so it really becomes a question of the deaf relatives that cause the

danger. Neither deaf persons nor hearing persons with deaf relatives should marry, and they certainly should not marry persons with deaf relatives.

One of the peculiar points brought out is a little difficult to state. It is that deaf persons who marry hearing persons are more likely to have deaf children than those who marry deaf persons. He says that if all the deaf persons in this list had married hearing persons, the number of deaf children would have been increased 50 per cent. That fact had been suspected for a good while, and Darwin refers to it in his *Variations of Animals and Plants Under Domestication*, and says that it is very puzzling and cannot be explained at present. An English writer says that intermarriage of the deaf carries the inheritance to such a point of perfection that it topples over of its own weight. That is perhaps only a paraphrase of what Darwin says.

Now, if you look through the whole list of these 10,000 names—for there were 5,000 marriages, though only 8,000 deaf people—you find that many more deaf persons have married hearing persons with deaf relatives than have married deaf persons with deaf relatives. Deaf persons who marry hearing persons, then, tend to marry hearing persons with deaf relatives, and it is no more than you should expect, that the deaf persons who have married hearing persons should have more deaf children than the deaf persons who have married deaf persons; it is the deaf relatives, remember, that are the index of danger, This result which so puzzled Darwin has received a clear explanation.

One other matter I should like to speak of in this connection. Some twelve years ago I was asked to prepare a discussion on the conditions necessary to produce a deaf variety of the human race. The paper was presented to the Royal Commission for Investigating the Condition of the Deaf in England and was published along with a number of others. I asserted that the only condition necessary was that persons with deaf relatives should marry and continue to marry generation after generation, and that is exactly the result that Professor Fay has arrived at. I was in a hopeless minority at that time. All the other scientific men who prepared papers on this subject holding that all that was necessary was that deaf persons should marry deaf persons for successive generations. Professor Fay's study shows that they were wrong, and my conclusion, reached some twelve years ago, turns out to be exactly what this very great volume of statistics proves, and leads to Professor Fay's advice. Deaf persons who are sure they have no deaf relatives, may marry other deaf persons without deaf relatives, or may marry hearing persons without deaf relatives with impunity; but those who have deaf relatives, whether hearing or deaf themselves, should be discouraged from marrying either deaf or hearing persons who have deaf relatives.

The cases in which the transmission of deafness is greatest and where it rises above 50 per cent is where the parties having deaf relatives, marry these relatives; that is, when the marriages are consanguineous marriages between persons with deaf relatives. The intermarriage of people with deaf relatives is almost sure to result in deaf children, more than half of the children being deaf whether the marriage is between deaf or hearing people.

**The Exhibition of a Three-months Infant with a Caudal Appendage.** DR. WATSON.

This infant has a peculiarity which I think is of sufficient rarity to be of interest to the Society. It has a tail. Its parents are not proud of it and want it amputated this week, so I exhibit the child to-night without having had time to look up the literature of the subject further than to ascertain that the condition is quite rare, although not unique.

It is a healthy male child a little over three months old. The tail springs from where a tail should, just posterior to the anus, and consists of two segments, a longer, thicker, more fleshy proximal segment, and a distal segment which is shorter, thinner and more fibrous. It is covered with normal skin. The length of the tail, when the child was three weeks old, was one and three quarters inches. Forty days later it was two inches and now it is two and a quarter inches long, having grown one half of an inch inside of three months;—apparently out of proportion to the growth of the rest of the body. It seems to have no connection with the coccyx, although it springs from the skin right over its tip. There seems to be no bony or cartilaginous tissue in it. It is well supplied with muscular tissue, and, in fact, the infant seems to express its emotions with the tail, for when the child is crying the tail shrinks up one half an inch in length, the distal portion partially telescoping within the proximal one. At other times it lies relaxed at full length or curls out upon the buttocks.

Dr. Harrison and I have secured some excellent photographs of the appendage. When it is amputated, Dr. Harrison will study it anatomically and we will make a further report.

**DISCUSSION.**

**PROFESSOR BROOKS.**—The South American Indians say that the white men wear clothes to cover up their tails. It is the custom to call abnormalities of this kind reversions, but it seems to me very doubtful whether you can regard them as anything like harking back to an ancestral type. Man, like all mammals, has a well-developed caudal region in the embryo, and its persistence is, I should think, simply a retardation of development. Normally, the tail stops growing at a very early stage; and, becoming very small and insignificant, forms the rudimentary coccyx. If that does not take place, there is a retention of the normal embryonic condition.

In this particular case you would have to go very far back to prove that there was harking back. The anthropoid apes have no more tail than man, and you would have to go back considerably beyond the primitive condition of these apes to find anything like a tail. It does not look possible that that could be the explanation when we have at hand such a simple explanation as the one I have given. You do not suppose that a hairlip is a throwing back to the condition of rodents; it is simply a persistence of embryonic conditions.

**Specimens of Cystic Kidneys.** DR. MACCALLUM.

Dr. Osler asked me to show one or two specimens from the museum. Cystic kidneys fall into two groups as he has mentioned, one like those passed around and one that occurs congenitally. The appearances as you see are rather different. The cysts as seen in childhood usually contain clear contents

and are of a different color. In connection with this, too, one usually finds some other changes. Here is the child from whom these kidneys were taken. There was a condition of hydrocephaly, and there were seven or eight fingers or toes on each hand or foot. The kidneys may be large enough to cause obstruction to birth, and in this case they had to be removed before the child could be delivered.

There are two theories as to their origin—the inflammatory, as described by Virchow, who thought the cyst-formation really the result of retention due to marked interstitial nephritis about the pillar of the kidney, and the non-inflammatory theory advocated by those who consider the cyst due to constriction of the tubules higher up as the result of chronic troubles; other authors think that the mere weakness of the walls of the tubules allows of the retention.

The French authors usually adopt the neoplastic theory, believing that it is simply due to proliferation of tissue bringing about the cystic growth. They describe them as adenocystoma.

Shattuck ascribes the formation of the cyst to the malposition of portions of the Wolffian body in the kidney, but some work recently done tends, I think, to rather disprove that. Rindfleisch ascribes it to failure of union of the cortical tubules with those of the medulla.

In connection with the cystic kidneys found in adults, as Dr. Osler stated, we sometimes find cysts in the liver, and here is a specimen which illustrates it. This is the kidney from a case seen by Dr. Thayer, which came to autopsy some time ago, and is almost exactly like the one passing around, but the liver in that case showed numerous small cysts.

*Monday, March 19, 1900.*

The meeting was called to order by the President, Dr. Thomas.

**Idiopathic Dilatation of the Colon.**—DR. FUTCHER.

This case is one of considerable interest. Usually rare cases come in pairs. Some time ago we had in the Hospital a case of dilated colon, which is now followed by this child with the following history: He is four years of age, and was born in Massachusetts. There was nothing especially remarkable about the child in the first few months. He seemed to be mentally a bright child for his age. At one year of age it was noticed that the abdomen was very large and its appearance soon became the talk of the neighbors. In 1898, he was taken to the Holyoke Hospital, where he remained under observation for a considerable time. Previous to that the child had been very constipated, going for six or seven days without a movement, and then such periods would be followed by severe attacks of diarrhoea. The movements were usually of a drab or whitish color. When constipated the child was especially dull, but at other times did not suffer and seemed quite bright mentally. Fortunately for the little fellow he was well taken care of by a nurse who became interested in the case, and up to the present time he has been carefully attended to, and has not been suffering. He has been getting irrigations twice a day.

The boy has a markedly distended abdomen, but not so



much now as when he came to us a week ago. There was then a very striking distention of the upper part of the abdomen, particularly above the level of the umbilicus. The abdomen is fairly symmetrical, and you see the child is well-nourished, and intelligent-looking. If you look at the child from the side you will see how pendulous the abdomen is, and how the distention is greater above the level of the umbilicus than it is below. No definite peristalsis can be made out even by stimulating with a cold towel. While under treatment during the last week he has been getting daily irrigations, and with each a fairly large constipated stool was passed. He seems quite comfortable except that the irrigations occasionally cause some irregular contractions, and at such times he complains of pain. The abdomen is now a little softer than on admission, and no fecal concretions can be made out by palpation, but that is not an indication that none are present, because the same condition was noticed in our other case, which was eventually found to have a large amount of fecal concretion in the colon.

The case is one of so-called idiopathic dilatation of the colon. There are three or four different types of colon dilatation. In the first class may be placed those cases in which there is simple gaseous distention. In the second group come those cases in which there is distention of the colon from contents of some form, either fecal, or foreign bodies introduced from without and more rarely by gall-stones. In the third group are those cases which result from organic obstruction in front of the distended bowel. Then there is the fourth group of so-called idiopathic dilatation of which this is the type.

Some believe that in these so-called idiopathic cases there is some actual constriction or stricture of the bowel in the region of the sigmoid flexure. Treves, I believe, holds this view and believes that it is always present. The colon becomes very markedly hypertrophied, that is, the muscular tissue of the wall is very much increased in thickness, but in the majority of cases no change has been observed in the mucosa.

One of the most remarkable cases is that reported by Formad in the University Medical Magazine, Vol. 4. It was a case of a dilated colon in a man 23 years of age. He was known as the "balloon man," which was an appropriate name as shown by the illustrations which I show you. The colon in this case was of enormous size, being as large as that of the ox, and when removed, weighed 47 pounds.

As to treatment there is not very much that can be done, and the cases generally terminate fatally early in life. If kept under careful observation, they may live with comfort for a considerable number of years. Surgical interference is advisable in some cases. Treves had a case in which he excised the greater part of the colon with a successful result. The operative procedure usually performed for relief of the symptoms is that for an artificial anus.

I will pass around photographs of the colored boy whom we had in the wards recently. In his case there was pronounced peristalsis which is usually a marked feature. This boy had an enormous abdomen. Passing up over the left half of the abdomen, crossing its upper part and occupying the right

hypochondrium was an enormously distended portion of the bowel which we believed was the sigmoid flexure, and which proved at operation to be such. This patient had the condition since he was eight years of age, and was fourteen years old when operated upon. He, too, gave the history of alternate constipation and diarrhoea. When he entered the hospital he had not had a movement for fourteen days. He was operated upon, the sigmoid flexure being excised, but unfortunately peritonitis set in and the boy died. The colon was enormously dilated, measuring 49 cm. at its greatest circumference. It contained large quantities of semifluid feces. At autopsy the colon contained about eight quarts of semisolid feces.

The advisability of a colotomy in this case is being considered.

#### Report of Gynecological Cases.—DR. MILLER.

CASE 1.—*Acute gonorrhœal peritonitis.* The patient was a young woman married just two months whose husband gave a history of having been treated in the dispensary here for two years for gonorrhœa. He had been pronounced cured by a competent assistant after repeated examinations of the slight discharge that still existed. Two months after marriage, at the menstrual period, the patient developed severe pain in the pelvis and the discharge was more profuse than usual. The pain occurred especially on the right side. In a few days the abdomen became distended and she had nausea, vomiting, elevation of temperature, and in fact all the signs of general peritonitis. She was sent into the hospital and operated upon by Dr. Kelly.

The entire picture and operation was that of peritonitis and the infection had evidently come through the tubes both of which contained pus which was discharging into the abdominal cavity. Both tubes were removed and she made an uninterrupted recovery. Although coverslips were negative and cultures on ordinary agar proved negative, I think it was a gonorrhœal infection. The infection came through the tubes, and to a woman who has never been pregnant there are practically only two kinds of infection through the tubes; first, gonorrhœal, and second, tubercular. I believe if we had had the proper media we should have grown the gonococci.

CASE 2.—*Ovarian abscess with general peritonitis.* In this case there was general peritonitis with pockets of pus in either flank, and free pus in the peritoneal cavity. She recovered after washing out the peritoneal cavity and removing the uterus and both tubes. She had always been healthy, but her periods had been irregular and painful. She had three miscarriages, the first two giving no trouble, but the third was the beginning of the present illness. Tenderness was excessive in both groins. No swelling had been noticed, but when she came in we found a lump in the lower part of the abdomen. Examination showed a pelvic mass on left side about the size of a large orange and intimately connected with the uterus. At operation the peritoneal cavity contained pus and there was a fibrinous deposit on all the intestines. There was a large abscess of the tube and ovary of the left side, which contained a yellowish brown offensive pus. The right ovary was cystic and adherent. Enucleation was done in the usual manner, but the patient's condition became so bad on the table that the pus

was imperfectly removed from the peritoneal cavity and a drain had to be placed in the pelvis. The pulse was so rapid and weak that she had to be infused repeatedly for the first night, but after that her recovery was satisfactory. The offensive odor of the pus led me to believe it was a colon-bacillus infection, but coverslips and cultures were both negative.

*CASE 3.—Suppurative Ovarian Cyst with Formation of Gas inside the Cyst.* The patient was a woman forty-three years of age, who had been admitted ten years previously on the medical side, but having refused operation for the removal of the cyst was discharged. She had severe pains at times, but kept her health pretty well until the last four months. When she came in she looked septic and was very weak. The elevation of temperature was not very marked. A tumor mass could be made out extending down into the pelvis and up into the abdominal cavity. It was tympanic over nearly the whole of its surface. This complicated the diagnosis very much. At operation the tumor was found to be an ovarian cyst densely adherent to the abdominal wall and intestines and having a very thick wall. Incision was made into the cyst and there was an immediate escape of gas and a very offensive brownish necrotic material containing some pus. Coverslips showed a bacillus that was thought to be too small for the gas bacillus, and cultures were negative. Five days after the operation cultures were again made and showed the colon bacillus, but probably that was not the nature of the original infection. She has improved greatly in general health, and the whole interior of the cyst-wall is gradually sloughing away.

#### NOTES ON NEW BOOKS.

Thirtieth Annual Report of the Massachusetts State Board of Health. (Boston: Wright & Potter Printing Co., 1899.)

This report contains about nine hundred pages of matter describing the work done under the direction of the Board for the year ending September 30, 1898.

The general contents and arrangement of the report are similar to those with which the many who appreciate the work of this Board have been familiar in past years.

It is a commendable characteristic of New England that the membership of efficient government boards is left unchanged from year to year in recognition of their services. The death of Dr. Charles P. Worcester, Chief Analyst in the Food and Drug Department, after ten years' service must be chronicled with regret.

The year 1898, in Massachusetts, was characterized by the greatest freedom from epidemics with one or two exceptions in the last half-century.

The typhoid death-rate has been reduced from 8.2 in 1871-75 to 2.5 during 1898. In this connection it may be noted that the work of Mark W. Richardson, in confirming for Massachusetts the observations of earlier investigators elsewhere, has called renewed attention to the transmission of typhoid fever through the urine of otherwise recovered typhoid patients. Richardson found typhoid bacilli in the urine in such cases in about 25 per cent of those examined, the bacilli persisting sometimes for considerable periods. The fresh urine may be even cloudy with organisms. It is a simple matter to "plate out," and to test the colonies thus isolated with typhoid serum or blood. This is worth the consideration of health officials in districts where typhoid is prevalent and water supplies are not well guarded indicating a possible method of cultural release from isolation on the same general principles as the release of diphtheria cases.

In diphtheria, the fatality for the pre-antitoxin, four-year period (1891-1894), was 28.3 per cent of cases; for the antitoxin period (1895-1898) 15.6 per cent.

In consumption it is gratifying to note a steady decrease. The classification of this disease, now universally regarded as distinctly infectious, under the "zymotics" is justly criticized, but is nevertheless retained in Massachusetts. Still this classification is not quite so bad as the retention of "alcoholism" under the same heading—a classification which seems crude if not absolutely barbarous—and only recently abolished. A State hospital for consumptives has been established. As illustrating the progress of sanitation in this disease, it is not out of place to note that Boston has now (1900) joined the list of cities in which the reporting of pulmonary tuberculosis is compulsory and in which disinfection is performed by the Board of Health after the death or removal of the tubercular patient. Combined with the supervision of tuberculosis in schools, these advances should contribute powerfully to the further reduction of cases in the future.

An outbreak of dysentery was investigated by O. Richardson, with the result that an organism regarded as *B. coli com.*, but unusually virulent, was isolated and considered as the pathogenic organism.

Under Filtration of Sewage, a good account of experimental work on the "septic tank" method for purification is given. While acknowledging that the present firm establishment of an unfortunate nomenclature in the literature of this subject makes it now somewhat difficult for isolated writers to introduce more appropriate terms, we think that the State Board of Health of Massachusetts carries sufficient weight in the scientific and sanitary world to make it well worth while for that Board to suggest a new phraseology. For instance, "septic" tank as a name for the receptacle in which bacterial decomposition of the sewage takes place might better be changed to "decomposition" tank. We feel particularly disposed to criticize the use of the term "toxin" in the statement made on page 442 to the effect that the formation of toxins in sewage is illustrated by the formation of gas under certain circumstances. Certain products of bacterial activities are classed as ptomaines. Only such ptomaines as are capable of producing toxic effects on animals are designated as toxins. It may be that the products of the bacterial decomposition of sewage are toxic to animals, but the experiment described certainly fails to illustrate or demonstrate such toxicity.

Mr. H. W. Clark contributes a paper describing a large number of experiments on the action of various waters on lead pipe, designed to determine the relation between the substances originally in solution in the water and the degree of action on the lead. It was shown that in general the active agents are oxygen and carbon dioxide, and that the purer the water, the greater the action. In waters showing high hardness, the action of the oxygen and carbon dioxide was reduced. Waters high in organic matter may not attack lead until the organic matter is decomposed and carbon dioxide thus set free. Iron, galvanized iron, zinc and block tin were also experimented with.

The engineers of the Board contribute a paper reviewing the working of the sewage filtration plants at present in operation in the State.

Under Food and Drug Inspection, the comforting assurance is given that the staples are almost never adulterated, and that the adulteration, when it is found, is rather commercially fraudulent than physiologically harmful. For instance, one hundred and forty-five samples of wheat flour tested yielded adulteration in only five instances, consisting only of a small percentage of corn flour. The cost of this inspection was about \$11,000 for the year. As the daily ration of the State is estimated to cost \$625,000 and for the year therefore \$228,125,000, it will be seen that the very valuable supervision of the supply costs but .005 per cent of the value of the material supervised. The articles most liable to adulteration are



milk, butter, spices, coffee, syrups, molasses, cream of tartar, honey, vinegar, jellies, jams, olive oil and certain kinds of canned goods. Preparations of foods for diabetic patients, advertised as starch-free or nearly so, showed in the majority of cases a larger percentage of starch than the limit claimed and sometimes as much as is present in ordinary wheat flour.

The report of the bacteriological laboratory is restricted to an account of the antitoxin results for the year and of the diagnostic work on diphtheria, tuberculosis and malaria. By an oversight in proof-reading, the tables (pp. 738-740) giving the results of the diphtheria cultural examinations have been made to show the doubtful results as reaching about one-third of the total cultures. The figures given under the heads of "Doubtful Cultures," and "Cultures Examined for Release from Quarantine," should be transposed, thus making the doubtful results only about 1 per cent.

Dr. S. W. Abbott contributes an exhaustive Life Table for Massachusetts.

The Series of Annual Reports from this Board are of such a uniformly high order that one can find but little to criticize. Compared with similar reports from other sources, these stand almost or quite at the head. Compared amongst themselves, however, we detect in the last two or three years a distinct dropping off in the contributions on original investigation which made former reports so valuable to others than statisticians, as well as to the latter. We should be glad to have a detailed account of the making of the various antitoxins carried out with such success by Dr. Theobald Smith. We think that a bacteriological investigation of the waters of the State, so thoroughly worked over on the chemical and "biological" sides, would furnish much information. With the improved technique, and the clearer conception of bacteriology developed of late years, a great deal of the disheartening confusion which exists in the present records of water bacteriology might be cleared up by a prolonged systematic and carefully worked out examination of the species to be found.

In ridding the State of typhoid-polluted water a great advance has been made, but doubtless there still remain some minor sanitary questions in the same line. The epidemic of dysentery already referred to suggests one of these.

In conclusion, we may again congratulate the Board upon this continued evidence of the excellence of their work.

HIBBERT WINSLOW HILL.

**The Anatomy of the Brain.** A Text-book for medical students.

By RICHARD H. WHITEHEAD, M.D., Professor of Anatomy in the University of North Carolina. Illustrated with forty-one engravings. (The F. A. Davis Co., 1900, pp. 1-96.)

Dr. Whitehead has done a real service to the medical students of America in preparing this volume. The surface anatomy of the various parts of the brain is first described, the classification of His and the nomenclature of the Basel Commission being adhered to. This is followed by a description of the internal anatomy of the same parts, the text being everywhere illustrated by somewhat schematic but accurate drawings. A section on the various conducting paths in the brain terminates the volume. The language is everywhere clear and simple, and the descriptions are systematically arranged. The student will find in this volume the simplest and at the same time the most accurate and concise introduction to the study of the anatomy of the brain in English.

### BOOKS RECEIVED.

**A System of Medicine.** By many writers. Edited by Thomas Clifford Allbutt, M.A., M.D., LL.D., D.SC., F.R.C.P., F.R.S., F.L.S., F.S.A. Volume IX. Mental Diseases and Diseases of the Skin. 1900. 8vo. XII+998 pages. The MacMillan Company, New York. MacMillan & Co., Ltd., London.

**The Journal of Experimental Medicine.** Edited by William H. Welch, M.D. Volume IV. With thirty plates and seventeen figures in the text. 1899. 8vo. XII+654 pages. D. Appleton and Company, New York.

**The Johns Hopkins Hospital Bulletin.** Volume X. 1899. 4to. 240 pages. The Johns Hopkins Press, Baltimore.

**Refraction and How to Refract,** including sections on Optics, Retinoscopy, the Fitting of Spectacles and Eye-glasses, etc. Two hundred illustrations, thirteen of which are colored. 1900. 8vo. XII+301 pages. P. Blakiston's Son & Co., Philadelphia.

**Transactions of the Washington Obstetrical and Gynecological Society.** Volume V. October 4, 1895 to June 16, 1899. 8vo. 456 pages.

**The International Text-Book of Surgery.** By American and British Authors. Edited by J. Collins Warren, M.D., LL.D., and A. Pearce Gould, M.S., F.R.C.S. Volume I. General and Operative Surgery, 947 pages. Volume II. Regional Surgery, 1072 pages. 1900. 8vo. W. B. Saunders, Philadelphia.

**Surgical Pathology and Therapeutics.** By John Collins Warren, M.D., LL.D. Second edition, with an appendix. Illustrated. 1900. 8vo. 873 pages. W. B. Saunders, Philadelphia.

**Saint Thomas' Hospital Reports.** New series. Edited by Dr. Hector Mackenzie and Mr. G. H. Makins. Volume XXVII. 1899. 8vo. 483 and 120 pages. J. & A. Churchill, London.

**Catalogue of the Anatomical and Pathological Preparations of Dr. William Hunter, in the Hunterian Museum, University of Glasgow.** Catalogue prepared by John H. Teacher, M.A., M.B., C.M. Two volumes. 1900. 8vo. LXXVII+943 pages. James MacLehose & Sons, Glasgow.

**A Pocket Medical Dictionary giving the Pronunciation and Definition of the Principal Words used in Medicine and the Collateral Sciences, etc.** By George M. Gould, A.M., M.D. Fourth edition, revised and enlarged, 30,000 words. 1900. 16mo. 837 pages. P. Blakiston's Son & Co., Philadelphia.

**Twentieth Century Practice.** An International Encyclopedia of Modern Medical Science by Leading Authorities of Europe and America. Edited by Thomas L. Stedman, M.D. In twenty volumes. Volume XIX. Malaria and Micro-organisms. 1900. 8vo. William Wood and Company, New York.

**Elements of Clinical Bacteriology.** For physicians and students. By Dr. Ernst Levy and Dr. Felix Klempner. Second enlarged and revised edition. Authorized translation by Augustus A. Eshner, M.D. 1900. 8vo. 441 pages. W. B. Saunders, Philadelphia.

**Report relating to the Registration of Births, Marriages and Deaths in the Province of Ontario for the year ending 31st December, 1898.** Printed by order of the Legislative Assembly of Ontario. 1900. 8vo. 50+CCXXII pages. Warwick Bros. & Rutter, Toronto.

**Essentials of Surgery.** Together with a full description of the Handkerchief and Roller Bandage. Prepared especially for students of medicine. (Saunders' Question Compend, No. 2.) By Edward Martin, A.M., M.D. Seventh edition, revised and enlarged. With an Appendix. Illustrated. 1900. 12mo. 342 pages. W. B. Saunders, Philadelphia.

**An Essay on the Nature and the Consequences of Anomalies of Refraction.** By F. C. Donders, M.D. Revised and edited by Charles A. Oliver, A.M., M.D. (Univ. Pa.). 1899. 8vo. VIII+81 pages. P. Blakiston's Son & Co., Philadelphia.

**Diseases of the Nose and Throat.** By J. Price-Brown, M.B., L.R.C. P.E. Illustrated with 159 engravings, including 6 full-page color-plates and 9 color-cuts in the text, many of them original. 1900. 8vo. XX+471 pages. The F. A. Davis Company, Philadelphia, New York, Chicago.



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# BULLETIN

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## NOTES ON THE PLAGUE IN CHINA AND INDIA.\*

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Aside from the recent outbreaks of Bubonic Plague which have attracted such widespread interest in themselves, there is something in the historical associations of the disease that has lent to them an added interest. Probably no other medical subject has been so extensively used for literary material as the Pest, for the dramatic and harrowing episodes of the great epidemics have afforded ideal material for descriptive writers who have availed themselves of its riches again and again. Thus Boccaccio, Defoe, Gibbon, Hodge, and others† have described the havoc it played in Europe when it was known as the Black Death. Accordingly, when, with the Philippine Commission, in Hong-Kong and later in India we had an opportunity of seeing the disease, it was evident that the facts of its epidemiology and environment were quite as interesting and certainly more dramatic than the clinical and pathological features of the disease itself.

The last recorded epidemic of note was that which occurred in Egypt in about 1825, and from that time to the outbreak in

Hong-Kong, the disease has been endemic in the central portion of China. Not much attention was paid to it, however, until Hopper‡ noted its existence in Yunnan. He says: "Despite of such a favorable climate, Mêng-tzū, in common with other parts of Yunnan, has suffered annually for a period of years from the plague, a kind of malignant fever, fatal in a few days, having as one of its symptoms a hard swelling in the neck, in the armpits, or in the groin, which has carried off a number of its inhabitants. On approach of the epidemic, the first victims are rats, which, fearless of human beings rush madly into their presence, and after capering around the room fall dead at their feet." From Yunnan the disease traveled to Pakhoi by one of the common trade routes, where according to Lowry and Horder, it has been endemic for over twenty years. In 1891, it broke out in Kao-chao, later in towns situated on the West River, and finally in 1894, a severe outbreak occurred lower down in Canton. Now, the infection of Hong-Kong proceeded either from Pakhoi or Canton; but inasmuch as Pakhoi is more than three times as far from Hong-Kong as Canton, and the Hong-Kong commerce with the latter port is hundreds of times greater than that with the former, it is probable that Canton was the source of contagion. Supporting this view is the following significant fact: On the second of March, 1894, a large Chinese procession was held in Hong-Kong, which was attended by over 40,000 Cantonese coolies of the lower class.

\* I wish to express my indebtedness to Prof. Simon Flexner and to Prof. L. F. Barker for permission to report these notes on the plague which were made while the Philippine Commission was on its trip.

† Boccaccio: The Decameron. Introduction. Defoe: The Journal of the Plague Year. Defoe: Due Preparation for the Plague. Hodge: Loimologia. Vincent: God's Terrible Voice in the City. Boghurst: Loimographia. Pepys: Diary. June 7th, 1665, to Jan. 19th, 1666.

‡ Imperial Maritime Customs, Annual Report, 1889.



At this period, tens of thousands were dying of the plague in Canton, and accordingly it is not improbable that the Island of Hong-Kong was inoculated then.

The first cases appeared in the district of Tai-ping-shan where the sanitary conditions are worse than in any other part of the city. (Properly speaking the city is called Victoria and the island Hong-Kong, but the latter name is now commonly used for the city as well.) In the native and European quarters of the city, Hong-Kong presents a strange contrast, for the European districts, from a sanitary point of view, are probably unexcelled in any city in the Orient; but the native quarter, notwithstanding some fairly broad, clean streets and new buildings, is really a whitened sepulchre. Here, in the tenements and side alleys, the coolies live in indescribable filth; the segregation and overcrowding being so great that at night the overflow sleeps in the streets. Many of these in the native districts are so narrow that one walking with outstretched arms can almost touch the buildings on opposite sides of the road. The houses are three or four stories high and originally contained fairly large-frugal rooms. The Chinaman, however, with his naturally frugal mind, subdivides them by cheap wooden partitions, and makes four rooms for one. With the decrease in the size of the rooms goes an increase in the number of their occupants, so that in one poorly ventilated tenement from 30 to 40 natives are huddled together, with less than 150 cubic feet of air-space per capita. As yet the coolie has not learned even the rudiments of personal hygiene, and the Chinese enjoy the unenviable distinction of being one of the filthiest peoples on the face of the earth. Apropos of this trait, some one has fitly called them practical Malthusians. One day in Hong-Kong we counted 14 coolies pulling and pushing a meat-cart that could have been drawn easily by a single horse; so, in a country where man and the horse show in a commercial ratio of 14 to 1, little in the way of civilization or personal aesthetics can be expected. As a rule the common coolie never cleans either himself or his houses.

In speaking of these questions Lowson\* says: "At the beginning of the outbreak a majority of the houses were in filthy condition. When to a mixture of dust, old rags, ashes, broken crockery, moist surface soil, etc., is added fecal matter, and the decomposing urine of animals and human beings, a terribly unsanitary condition of affairs prevails; and that this is no overdrawn picture of what was to be met with in Tai-ping-shan, many Europeans now know to their cost." One must recall, moreover, that Hong-Kong is Europeanized China, and that the conditions prevailing there do not compare with those found in Canton, for example—a typical Chinese city like those in other parts of the celestial Empire. Indeed, in comparing it with Canton, there is something almost Utopic about the sanitary condition of the native quarters of Hong-Kong.

Once begun, the epidemic was fought by the following general sanitary measures: (1) Removal of the sick and dead. (2) Temporary segregation of those exposed while the premises were being disinfected. (3) Cleansing and disinfecting of "infected premises." (4) Disinfection of clothing. (5)

General cleansing and limewashing of all tenement houses. (6) House-to-house visitation. (7) Disinfection of public latrines. These measures were all carried out with a considerable degree of success—much more success than attended the similar ones established later in India. This is due partly to the fact that the Chinaman is more easily bullied by sight of power than the Hindu, and partly because the customs offended by the plague regulations are, in China, for the most part merely personal and are neither national nor religious.

During the height of the epidemic the medical staff had more to do than it could accomplish, but by the aid of a number of British soldiers, especially assigned to plague duty, managed to keep up the routine work necessitated by the sanitary plague regulations. In this work the greatest opposition came from the unwillingness of the Chinese to send patients into the hospitals and the resistance they made to house-to-house inspection. In the secretion of cases, moreover, they often went to unheard-of extremes, and the district inspectors in their search for patients often saw sights that it seems almost impossible to believe. Dr. Lowson says, for example: "To overpaint the pitiable surroundings associated with plague work at the commencement of the epidemic would be impossible. I have entered a long, low cellar, without any window opening, and with air entering only by a square open shaft from the level of the roof three or four stories high. Down one side of the shaft ran a broken earthenware drain-pipe, leaking freely, the contents streaming down the wall of the air-shaft to a shallow pool of filth which crossed the undrained floor of earth. Although it was broad daylight outside, a lantern was necessary to see one's way. On a miserable sodden matting, soaked with abominations, there were four forms stretched out. One was dead, the tongue black and protruding. The next had the muscular twitches and a semi-comatose condition heralding dissolution. In searching for a bubo we found a huge mass of glands extending from Poupart's ligament to the knee-joint. This patient was beyond the stage of wild delirium. Sordes covered the teeth and were visible between the blackened and parted lips. Another sufferer, a female child about 10 years old, lay in the accumulated filth of apparently two or three days, unable to speak owing to the presence of enlarged cervical glands. The fourth was wildly delirious and was constantly vomiting. The attendant—the grandmother of the child—had a temperature of 103° F. and could only crawl from one end of the cellar to the other. She was wet through and was herself doomed. This is no fancy sketch but a true picture of how we found some of the patients at the outbreak of the scourge in Hong-Kong. No one unfamiliar with the horrors of the coolie accommodations in China, could credit how the poor live in Hong-Kong, or could imagine how the horrors of their everyday life were intensified by the plague." In disinfecting some infected premises one day Dr. Lowson told us that in one room the inspectors were forced to dig through two feet of dirt and human excreta to reach the floor.

The mortality from plague in Hong-Kong among the Chinese varies between 91 and 93 per cent, so that almost all of those afflicted, no matter what their treatment, die. Naturally, in view of these facts it is not astonishing that the

\*Lowson: J. The Epidemic of Bubonic Plague in 1894. Medical Report, Hong-Kong, 1895.



coolies rebel against sending their sick into the hospitals, for there the tremendous mortality is emphasized much more than it would be in cases that remained at home. Both in the Tung-Wah Hospital and Kennedytown Hospital for infectious diseases, wards are set aside where those who elect may receive native treatment. Of course, this practically amounts to a recognition of the quackery of the Chinese doctors on the part of the government, which thus officially assumes the responsibility for their treatment. This practice is now being strenuously opposed by the Colonial medical men.

During our visit to Hong-Kong, the plague was quiescent and there were only from 16 to 20 deaths a day from the disease. The house to house visitation at this time had been given up, so that the majority of these cases were found dead on the streets and were carried by the inspectors to the mortuary. On entering the morgue each morning the sight was a ghastly one, for the bodies were lying about on the



DR. JAMES A. LOWSON, CHIEF PLAGUE OFFICER AT HONG-KONG, IN FRONT OF THE KENNEDYTOWN HOSPITAL.

tables waiting until the hasty autopsies, necessary for burial, could be performed. Many that had not been discovered promptly were fly-blown, while other cadavera that had for several days been lying undiscovered in obscure places were half-eaten by maggots before they were carried to the mortuary. The disposal of cases that die after successfully eluding the vigilance of the district inspectors is facilitated by the habit which the coolies have of sleeping on the streets during warm nights. In Hong-Kong, during the hot season, night shows many weird and picturesque sights. The little narrow streets in the native quarters, lighted dimly by the flickering street-lamps are simply covered by the sleeping coolies who are drawn from the crowded and poorly ventilated houses by the stifling heat. They are so crowded that one cannot walk for any distance without stumbling over the half-naked sleepers who lie stretched out on little pieces of matting. So when a secreted plague patient dies, he is carried out by relatives and laid in the

street among the sleeping forms. Most of these rise at dawn to go to work, and those that do not are usually taken later to the mortuary by the plague inspectors.

The mortuary is situated half-way up the hill on the outskirts of the city toward Canton, and consists of a modern deadhouse, an office for the government medical officer, and quarters for the native care-taker. The first striking thing about the plague bodies was the presence on many of two parallel rows of deep purple spots about the size of a Spanish dollar extending from the sides of the neck down on to the chest. At first sight these appeared to be a new manifestation of the disease until Dr. Lowson told us that these purpuric spots were the result of the Chinese method of counter-irritation. This consists in firmly pinching the skin between the thumb and forefinger until it is bruised. As there is, in plague, a general tendency to hemorrhagic extravasation into the skin and serous membranes, the blood oozing from the torn vessels into these traumatic areas soon turns black, and gives the appearance which we first noted. Mosquito and flea bites behave in much the same manner. Likewise the slightest scratch or



SMALLPOX WARD AT THE KENNEDYTOWN HOSPITAL.

bruising of the skin is apparently always followed by a pink blush, and later by a subcutaneous hemorrhage which soon changes to a dark purple-colored spot. In many cases we observed extensive bullæ filled with blood-stained serum, and in one or two instances the idiopathic hypodermic hemorrhages which gave the disease its mediæval name of the Black Death.

The main plague hospital in Hong-Kong is now at the old Kennedytown Barracks, in the extreme outskirts of the city, which have been converted into a hospital for infectious diseases. Here principally plague and smallpox cases are received. The hospital occupies a commanding position at the foot of Mount Austin, from the base of which the grounds extend to the water's edge. The main building, a substantial stone structure overlooking the mouth of the West River towards Kowloon, is covered by stucco, and contains the laboratory, offices and a few wards. The major part of the hospital, however, consists of rude matsheds made of palm-<sup>thatched</sup> walls and roof stretched over bamboo frames. They have rough board floors, and are lined by coarse matting. On the whole they make a fairly hygienic hospital, except that thorough disinfection of the wards is impossible. A few

supported on piles over the water's edge are perhaps more sanitary than the rest, because they get air and sunlight in greater abundance. As a rule these wards are large enough for four or five patients, their small size being a decided advantage, as convalescents and those in the early stages of the disease are thus kept from witnessing the depressing scenes



A ROW OF PLAGUE WARDS IN THE KENNEDYTOWN HOSPITAL.

that often occur when patients are in the delirious stages of the malady. Plague patients do not have beds or cots but lie on a platform made of boards, supported by ordinary carpenter's horses, over which is spread a small oblong piece of matting. They have no bedding, and their heads rest on the peculiar Chinese pillows which look more like bamboo rat-traps than



MATSHEDS AT THE KENNEDYTOWN HOSPITAL, WHERE NATIVE TREATMENT IS GIVEN.

anything else. When patients get in the maniacal delirium that often accompanies the acute stage of the disease, they are tied down on their rough litters by cloth thongs. A patient so controlled can be seen in the accompanying photograph. In the male wards there are coolie attendants while the women

are nursed by amahs. Besides the Kennedytown Hospital, there were during the days when the epidemic was at its height several other temporary hospitals established in the city, and a floating hulk, the *Hygeia*, nicely fitted up and anchored off the Kennedytown Hospital, was used for European and Japanese patients. Aoyama, the Japanese physician who was infected from an autopsy wound, was treated on this ship.

Epidemics begin in the bubonic form, and when the epidemic is at its height and the mortality is greatest, changes to pneumonic plague, and finally in the defervescence stage dies off again in the bubonic type. This has occurred regularly in Hong-Kong, and has been noted in the many epidemics that have occurred in India by the plague authorities there. Atmospheric conditions do not seem to have much influence on the disease, except that during the rains, people are driven into the crowded, dirty houses, where they are more exposed to infection; and the bacilli, moreover, are protected under these circumstances from the dessicating and bactericidal action of the sun's rays. This, Kitasato has shown, is one of the most potent agents in the destruction of the plague bacillus.



PLAGUE PATIENT UNDER RESTRAINT IN THE HONG-KONG PLAGUE HOSPITAL.

exposure for an hour usually being quite sufficient in temperate climates to destroy the germ. Epidemics are usually heralded, by a great mortality among the rats, which seem, when affected with plague, to lose all fear of human beings and run boldly about the houses. In part, at least, the infection of the rats can be accounted for by the ingestion of septic material, *i. e.*, sputum and dejecta of plague patients, but by far the most prolific cause of its spread is by fleas. It is well known that fleas soon leave the bodies of rats dead of the plague, and it is supposed get on to other healthy uninfected rats. The agency of these insects as transporters of the disease has been shown by Simond\* and by Lowson who put fleas from plague rats on healthy rodents, and found that they died of the disease in about three days. Flies and mosquitoes, however, do not seem to play such an important rôle in the transmission of plague to human beings, for both infest the wooded area about the Kennedytown Hospital, and yet no one of the attendants there

\*Simond: "Propagation de la peste" *Annales de l'Institut Pasteur*, Oct., 1898.

was ever infected. By far the most important atrie of infection for human beings are through abrasions of the skin, through the mucous membranes of the respiratory tract, and to a lesser degree through the alimentary tract. Plague, like any infectious disease, thrives where sanitary conditions are poor; and in China and India finds naturally ideal conditions for its spread among the hordes of natives whose lives of misery and squalor form the dark side of the human picture in the Far East.

The symptoms and bacteriology of the pest have already been well described in the translations of the papers of Kitasato and Aoyama which appeared in this journal some years ago\* so reference will be made only to some of the more important points which were brought to our attention in India and China. It appears that the disease may exist in any of its forms alone, or two or even more may simultaneously complicate each other in the same patient. In the simple bubonic type the location of the bubo indicates that the portal of entry of the infection occurred in the area drained by that set of lymph-glands, but it is also not uncommon to find glands enlarged *en échelon*. Thus, in one of our Hong-Kong autopsies the femoral, inguinal, iliac and lumbar groups were all enlarged and hemorrhagic. From the observations made at the Arthur Roads Hospital in Bombay, based upon the study of a large number of cases, the site of the buboes occurred as follows:

Femoral, . . . . .	32.12	per cent.
Femoro-inguinal, . . . . .	23.36	" "
Axillary, . . . . .	16.35	" "
Inguinal, . . . . .	12.38	" "
Cervical, . . . . .	5.25	" "
Multiple, . . . . .	4.67	" "
Total . . . . .	94.13	" "

The frequency with which the buboes occur in the lower sets of lymph-glands is explained by the fact that both in India and China, natives of the lower classes go barefoot. But in this connection it is worthy of note that all of the men in the Shropshire segment in Hong-Kong who were attacked with the plague while on inspection duty had femoral or inguinal buboes, even though they were well-booted. Their trousers, however, were open at the bottom, admitting dust particles laden with plague bacilli. While on similar duty in India, the soldiers always wore puttees, and not a single case was reported among them.

In most cases the buboes are exquisitely tender and generally require local applications to relieve the pain. For this purpose the ice-bag has been used with good effect in India. Between the portal of entry and the enlarged glands, there is often a well-marked lymphangitis and at different points multiple lymphatic abscesses may occur. This was particularly marked in Aoyama's case. When we met him in Japan, he showed us the scars of the numerous incisions made to relieve the condition about which there was a slight tendency to the formation of keloid. This has been repeatedly observed in

Hong-Kong among the Chinese who have recovered after a complication of suppurating buboes or lymphatic abscesses. Most of the buboes do not suppurate, but the fact that the great majority of cases die within two or three days after the onset undoubtedly bears a relation on this point. Likewise, it seems that mixed infections have a very important influence on the question of suppurating as the following figures show. In the pus of 29 suppurating buboes examined by the several continental commissions working in Bombay, the following results were obtained:

Bacillus pestis, . . . . .	8
Staphylococci, . . . . .	9
Streptococci, . . . . .	5
Sterile, . . . . .	7
Total, . . . . .	29

A suppurating plague bubo forms a most indolent ulcer and the granulations at the base sprout with such reluctance that it may take months for them to heal. Fortunately in these old chronic ulcerations the pus is usually sterile. In one case in Hong-Kong, followed by recovery, the femoral vessels lay exposed in the base of a large slough about a suppurating bubo.

The incubation period in plague varies between three and nine days, but in the majority of cases averages about five or six. It seems that there are no constant prodromata, and the onset, as a rule, is sudden, marked by headache, fever, backache, and a general feeling of malaise. Vomiting of a blood-stained fluid has been observed not infrequently at the onset, a phenomenon due to the action of the plague toxin in the mucous membrane of the stomach which, at autopsy, is nearly always injected and ecchymotic. In Hong-Kong, they were in the habit of speaking of the plague facies, which Lowson believes is often of assistance in the diagnosis of the disease. It consists of a mixture of anxiety, cyanosis, and dyspnea, and in mentioning it Lowson says: "Generally speaking, there is something indescribable in the face of the plague-stricken which seems to help your diagnosis—an expression as if the sufferer himself knew all about it, and his inner consciousness had left its mark upon his features." There is something quite characteristic about the plague tongue, which has a heavier coating than in typhoid fever and is considerably clearer about the margins. Soon the coating turns black and sordes often cover the teeth and lips. After the onset the fever usually rises rapidly and reaches its maximum in from 12 to 24 hours. The common temperature ranges from 103° to 105° F., but cases with a fever as high as 108° are not infrequently observed.

The patient soon after the onset shows evidence of great prostration. The pulse, at first, is full and bounding, and later becomes feeble and collapsed. Dicrotism is very common, and the heart, in the majority of cases, needs repeated stimulation to overcome the cyanosis. The cardiac symptoms observed clinically in plague cases conform in general to the results obtained experimentally by the injection of the toxic nucleoprotein of the Pest bacillus into animals. Lustig and Galeotti have also shown† that the subcutaneous injection of

\* Flexner: Bulletin of The Johns Hopkins Hospital, Vol. VII, Oct., 1896.

— Bulletin of The Johns Hopkins Hospital, Vol. V, Oct., 1894.

† Lustig and Galeotti: Lo Sperimentale, 1898.



large amounts of the plague toxin into animals is followed by a local thrombosis at the point of inoculation, and that the blood-pressure in dogs falls rapidly to 10-15 mm. of mercury, accompanied by a progressive diminution in the force and rhythm of the heart-beats soon resulting in death.

On the second or third day, the cerebral symptoms usually appear: these consist of a general apathetic condition on the part of the patient, coma or delirium of varying degrees. During this period it is often difficult to get the patients to take nourishment, and the attendants must resort to strategy or rectal feeding. This was notably the case with Doctor Aoyama, who could only be tricked into taking nourishing draughts by appealing to his politeness, on the one hand, and his patriotism on the other, by alternately toasting Queen Victoria and the Mikado in champagne, milk and other nourishing and stimulating beverages. During this period of the



ONE OF THE PLAGUE STREETS, POONAH.

disease symptoms of meningeal involvement and cerebral hemorrhages were sometimes observed.

The respiratory symptoms in most cases consisted of a marked hypostasis owing to the marked cardiac weakness; but when the pneumonic type of plague was present, the condition was more often of a lobular type. In uncomplicated cases the plague bacillus can be found in the sputum, but oftentimes there is present a mixed infection with the pneumococcus. Edema of the glottis and extensive laryngitis were also found in some of the Bombay cases. During the course of the disease, as well as at the onset, vomiting occurs and the vomitus in such cases is stained with both bile and blood. The spleen is palpable and remains so during the course of the disease. There is always some albumin in the urine, but it is small in amount; likewise casts, epithelial debris, and occasionally Plague bacilli are also found. In general the disease runs its course in five or

six days, but the fever may remain elevated for weeks especially in cases where there is a secondary pyæmic infection. Death in most cases occurs from heart failure. No cases of reinfection above suspicion have been reported, but relapses are not uncommon during convalescence and result usually from local extension from the original focus of the disease.

Between the plague in China and India there are many points of difference which depend, it seems, partly on the character of the natives. In China the pest is more fatal than it is in India, the death-rate among the Chinese being 93 per cent, and only about 82 per cent among the low-caste Hindus, who are the heaviest sufferers from the disease in India. The general standards of life and personal hygiene are much lower among the Chinese than they are among the Hindus; but for some reason the epidemics are so much greater in India that the terrible effects of the disease are more obvious and its many horrors are impressed on the observer by the magnitude of the sufferings of the natives. Since the first outbreak in India, in 1896-7, the death-rate has constantly increased each year, until, in 1899, more than 50,000 people died of plague in the City of Bombay alone. Moreover, the disease has now spread in a



PLAGUE FUNERAL IN INDIA.

large part of India and has appeared in Bengal, Madras and many points in the Bombay Presidency. The really serious part of the question is that apparently it is still on the increase, and precisely what the end will be no one at present can foretell. The Colonial Government, however, is doing all in its power to stamp out the disease, and no experiment is left untried that offers the slightest hope of solving this very serious question.

The plague measures in India are much like those in Hong-Kong except that they are, perhaps, not quite so thorough. In India the plague authorities have had to fight against the bigotry, opposition and animosity of the native who gives far more trouble to the sanitary authorities than his celestial neighbor. Here exist the ideal conditions for the spread of any disease; namely, overpopulation, overcrowding, malnutrition, unhealthy environment and crude and unclean methods of living. Under these conditions the energy required to fight the plague in India has been tremendous because of the inertia of the vast population, which even looked with disfavor on the measures meant for its good. In Bombay alone, the plague

expenses for the first year of the epidemic amounted to over fifteen lakhs of rupees.

Certain facts concerning the plague epidemics of India have been more fully described in another place;\* but the methods of treatment employed in India and the results obtained in their use are of the greatest importance. No effort or expense has been spared by the Indian government to try any method that offers any hope of relieving the distressing conditions. To this end, the Bombay Presidency has fitted up the old government house at Parel as a plague laboratory, and here the plague prophylactic of Haffkine and Lustig's *Heilserum* are manufactured. Yersin, it appears, was the first to manufacture a serum supposed to act as an antitoxin to the poisons produced by the plague bacillus. Like the diphtheria antitoxin it was made on the assumption that the plague toxins were soluble products of the growth of the pest bacillus and could be obtained from filtered fluid cultures of the organism. The first cases treated by the antitoxin were in China and the results, it is stated, were very satisfactory. Somewhat later



WARD IN POONA PLAGUE HOSPITAL. THE PATIENT COVERED WITH A BLANKET IS DEAD

several plague patients at the Arthur Roads Hospital in Bombay were inoculated with the antitoxin, but the results were practically negative; so, from lack of both results and material, further experiments with Yersin's serum were not undertaken. In the Oporto epidemic Calmette† used Yersin's serum and reports excellent results with it. Two facts, however, should be noted, *i. e.*, that the number of cases treated in India was too small to allow any conclusions as to the real value of the antitoxin as a therapeutic agent to be drawn, and, on the other hand, that the cases occurring in Portugal were by no means as severe or fatal as those among the natives of Bombay.

Then some time later Haffkine,‡ making experiments along

\* Barker and Flint. "A Visit to the Plague Districts of India." New York Medical Journal, Feb., 1900.

† Calmette: Presse Médicale, 1899.

‡ Report on the Outbreak of Bubonic Plague, 1896-97. Bombay, 1897.

the same line reported to the health commissioner that his efforts to obtain an antitoxin for plague by methods similar to those used by Behring, Kitasato and Roux for diphtheria were unsuccessful and that his experiments resulted negatively. At a later period Lustig and Galeotti§ had a similar experience, but they found, however, that the essential toxin was situated in the body of the plague organism and was of the nature of a "*nucleoprotein toxique*." They succeeded in isolating this toxin by the following method: A three days' growth of the plague bacillus on large agar plates is scraped off and dissolved in 1 per cent KOH. This solution is filtered and acidulated with dilute acetic acid, whereupon it yields an abundant white precipitate which is washed and dried and in this state can be kept indefinitely. It is prepared for use by dissolving in a dilute solution of sodium bicarbonate [0.5 per cent]. This *nucleoprotein toxique* is soluble in alkalis and insoluble in dilute acids. In general it gives the proteid reactions and by artificial digestion can be split up into peptone and an insoluble nuclein. When injected experimentally it produces the symp-



LOW-CASTE HINDU DEAD, POONA MORTUARY.

toms which we have already described. It is from this *nucleoprotein toxique* that the antitoxin is manufactured by injecting it into a horse. The quantity used naturally depends a good deal on the condition and strength of the animal. The injection is followed by a violent reaction at the site of inoculation; an area of localized edema half as large as a man's head may persist at the point of inoculation for many days. We saw that condition in one of the horses at the Parel Laboratory in Bombay. These large injections are repeated as often as the condition of the horse permits until the required degree of immunity is produced. Then the serum is withdrawn and prepared in the usual way. As yet the number of antitoxic units has not been determined by animal titration, and the preparation of the serum in large quantities has only just begun. The complete reported results thus far include 175 inoculations, with 100 deaths, and 75 recoveries, or a mortality of 57.30 per

§ Lustig and Galeotti: Lo Sperimentale, 1898.

| Galeotti: Arch. des Sciences Biologiques. Tome VIII, 1899.



cent. Thus, the mortality for plague averages about 73.70, so that, at present, the serum saves about 16 per cent of the cases. In these inoculations the cases were not selected but were taken as they came, and included 18 in which dissolution was imminent. After the injection a hypothermic action was noted which seems in plague cases to be a specific reaction, as it was never obtained when people who were not suffering with plague were inoculated. At times considerable prostration seemed to follow the injection and a slight increase in the cardiac weakness so that caffeine, camphor or ether were often given with the antitoxin. After the second injection there was an amelioration of the conditions. The antitoxin, according to Galeotti, acts in a manner exactly opposite to the *nucleoprotein toxicus*. The pulse becomes less frequent and the dicrotism disappears; there is an augmentation in the force of the heartbeat, while the buboes, at the same time, become less painful, and any tendency to suppuration is arrested. Bacilli, moreover, tend to disappear from the blood. In pneumonic cases and in the severer gastro-intestinal infections, the antitoxin in its present strength apparently has no effect.



CHILD DEAD OF PLAGUE. POONA MORTUARY. PREPARATION FOR FUNERAL.

Soon after the outbreak of plague in India M. Haffkine, formerly of the Pasteur Institute, who had been at work in India on some problems concerning cholera, began the preparation of a prophylactic against plague.\* The principle involved in the preparation of that fluid is similar to that followed by Lustig somewhat later in the manufacture of his *Heilserum*; namely, that the plague toxin resides in the body of the pest bacillus, and cannot be obtained from the soluble products of its growth. The preparation of the Haffkine prophylactic fluid is now carried on, on a large scale, in Bombay; and it is shipped all over India and to many other parts of the world. At present the prophylactic meets with great opposition from the natives, especially the Hindus, who will not submit to inoculation because the fluid contains meat, and thus offends one of their most cherished religious principles. To meet this

\* Haffkine: The plague prophylactic. *Ind. Med. Gazette*, June 1897.

— Remarks on the plague prophylactic fluid. *Brit. Med. Jour.*, 1897, Vol. II.

objection an effort is being made to procure a medium on which to grow the organisms from a substratum gluten and other substances free from meat extracts.

The manufacture of the prophylactic is quite simple, and through the kindness of Dr. Melne, who had charge of the Parel Laboratory in Haffkine's absence, we were able to follow the prophylactic through the various stages of its preparation. A kilogram of finely chopped goat's flesh, after macerating in hydrochloric acid, is placed in an autoclave and heated for six hours under a pressure of three atmospheres. This is then filtered and neutralized with KOH and diluted up to three litres, when it becomes the medium in which the plague bacillus is grown. Some plague material is put into these flasks and the bacillus is identified by what Haffkine has described as the stalactitic growth. If such cultures rest absolutely undisturbed for five or six days, after being inoculated on the surface, fine delicate thread-like processes can be seen hanging from the surface into the depths of the bouillon which have a very strong resemblance to the stalactites that hang from the



MOHAMMEDAN GIRL BEING BURIED BY THE HOSPITAL AUTHORITIES.

roof of a grotto. This growth, according to Haffkine, is pathognomonic of the plague bacillus, and the purity of such a culture can be tested microscopically. The culture is put into a Pasteur flask, from which a large series of 3-litre flasks are inoculated after it is certain that the original culture is uncontaminated. These are grown in a huge, darkened room, containing long tables on which hundreds of these 3-litre flasks rest. Owing to the high mean temperature thermostats are unnecessary in India. To make the prophylactic it is necessary to get repeated crops of the stalactites in each flask and to keep the surface inoculated; a small amount of sterile "ghee," a sort of clarified butter, which floats on the surface and always contains after the original inoculation a few bacilli, is added so that after repeated shakings the surface of the culture is always reinoculated. In this way five or six crops of stalactites are obtained before the serum is finished, and this takes, as a rule, about six weeks. After agitating the flasks, the little clumps of bacilli sink slowly to the bottom and a new surface growth slowly appears. The culture is killed by immersion in a constant water-bath at



70° C. for three hours when some carbolic acid or thymol is added, and while care is taken to keep it well shaken the prophylactic is decanted into small bottles and is then ready for use.

The usual dose of the plague prophylactic was about 2 cm., but at Hubli, where it was used most extensively, Leumann\* was in the habit of using a greater quantity at each injection. He always took into consideration, however, the age and physical condition of the patient in making the inoculations. An ordinary antitoxin syringe is used for this purpose and the injection made well into the subcutaneous tissue. Injections into the skin are apparently more painful than those made well below the corium. After two inoculations with the plague prophylactic the blood of the patient usually gave the Widal reaction. This, however, is not obtained so readily after a single protective injection. Leumann allows from 14 to 20 days to elapse between the first and second injections, and regards the constitutional reaction of headache, fever and malaise as more important than the agglutination test. Extremes of age do not seem to affect the value of the inoc-



BURNING GHÁT, POONA PLAGUE HOSPITAL.

ulation, as on one occasion a child 10 days old was inoculated while on another, a woman of 90 was protected against the disease. Women as far advanced in pregnancy as the seventh month were inoculated without the occurrence of any unfavorable symptoms, a fact which is rather interesting when one considers that all pregnant women taking the disease itself abort. To avoid, as far as possible, the injection of the protein in the incubation stage of the disease, it was regarded as safe rule not to inoculate any one with a temperature of 100° F. until it was certain that he was not suffering from the plague.

Since it has now been generally recognized that, under the conditions which obtain in India, the hygienic and sanitary measures have little or no effect in influencing the course of the epidemic or lessening the mortality from the disease, the results obtained at Hubli have been most successful and gratifying. In all some 78,000 inoculations were done in a period of four months in Hubli, in the province of Dhárwār, many of

which were, however, on the inhabitants of the outlying districts and villages. It seems that the double inoculations have a greater protective power against the disease than single injections of the prophylactic, which statistically is shown to amount to 10 per cent of the total mortality among the inoculated. But in Dhárwār the results were even better than at Hubli; for there were, among 4,926 single inoculations, 45 cases and 15 deaths; and in 3,387 double inoculations, 2 cases and 1 death.

Moreover, among these inoculations were undoubtedly included some cases where the prophylactic was given to those in the incubation period of the disease. Hubli, where the Haffkine serum received its first large and comprehensive test, is a mercantile town of about 50,000 inhabitants. It was attacked by the pest at the beginning of the monsoon rains, and the average monthly rainfall between October and April reached 28 inches. Although a large health camp was established, and as many plague regulations as possible were put in force, it was evident that the authorities could not cope with the epidemic, so they determined to make a thorough test of the prophylactic. Mr. Cappell, the collector of Dhárwār, says: "If this experiment had failed, the mortality, judged by the actual mortality among the uninoculated, would have been appalling. All possible sanitary measures in the shape of disinfection, unroofing of houses, and segregation were applied concurrently with the inoculation as the government is already aware; but the rate of mortality among those who held back from inoculation rose at one time to a height which, I believe has never been approached elsewhere—standing in the third week of September at the figure of 657 per thousand per week."

The duration of the protection afforded by the serum could not be definitely determined, although the majority of the citizens were protected for at least 5 months. In 69 households, all of the inoculated members escaped the disease while some of the uninoculated in the families succumbed to the disease. Perhaps a more conclusive idea of the scope of the enormous experiment may be gathered from the appended table, which shows that at only one period did the non-inoculated have a percentage advantage over the inoculated in the mortality tables and that was when the epidemic was not severe and the number of the inoculated was low.

DATES.	Number of non-inoculated in Hubli.	Number of twice inoculated in Hubli.	DEATHS FROM PLAGUE AMONG		PERCENTAGES IN EACH GROUP	
			Non-inoculated.	Twice inoculated.	Non-inoculated.	Twice inoculated.
Five weeks from 14th May, 1898, to 14th June, 1898.	11,573	531	47	11	...	18
Week ending						
21st June, 1898, .....	11,494	2,220	22	4	...	100
28th June, 1898, .....	39,042	3,566	30	Nil	...	64
5th July, 1898, .....	36,020	5,160	55	3	...	72
12th July, 1898, .....	33,255	7,289	31	2	...	67
19th July, 1898, .....	29,716	7,959	52	0	...	85
26th July, 1898, .....	21,112	10,311	100	0	...	25
2nd August, 1898, .....	21,031	12,660	110	0	...	96
9th August, 1898, .....	15,581	15,845	272	14	...	96
16th August, 1898, .....	10,685	19,191	365	31	...	96
23rd August, 1898, .....	6,397	23,392	371	20	...	96
30th August, 1898, .....	1,691	26,547	328	20	...	96
6th September, 1898, .....	2,731	28,671	227	23	...	96
13th September, 1898, .....	1,116	30,911	113	30	...	96
20th September, 1898, .....	475	31,483	106	21	...	96
27th September, 1898, .....	603	31,872	58	16	...	96

\* Report No. 7569, of 1898.

## A STUDY OF CHRISTIAN SCIENCE.

By HARRY T. MARSHALL, M. D., *Fellow in Pathology, The Johns Hopkins University.*

As it is useful and interesting in the field of medicine to examine into the conditions and causes of diseases, not only for the object of curing them, but in order to understand the reasons for their existence: so, in the same way is it profitable to examine those products of civilization which may well be considered diseased, not treating them as things of no interest, but as curious pathological products, whose origin and condition it is worth while to investigate, and whose causes are of interest because they show, to a certain extent, the workings of the human mind.

Particularly must we remember, that, however irrational and absurd the condition may be, it is still the result of definite, actual forces, which can be studied and treated reasonably, in just the same way that the problems presented by a fever or an inflammation can be handled.

This evening we will consider one of the pathological conditions affecting society—a condition not unlike insanity, but a condition that affects a very large part of the community, that appears to have a strong foothold, which is powerful from the number, character and wealth of those affected by it, and which is a menace to the health and safety of the community.

In my paper this evening I will consider various features of Christian Science.

Christian Science originated in 1866, the "discoverer" being Mrs. Mary Moss Baker Glover Patterson Eddy. For upwards of ten years she developed the system, gradually gaining adherents among her acquaintances and finally in 1875 she published her book, "Science and Health with Key to the Scriptures." This marks the official beginning of the "Science." Since that time, largely owing to the energy and zeal of Mrs. Eddy, the number of her followers has been increasing with great rapidity and her "discovery" has been spread over one-half the world. At the present day the rate of increase is very high, and Christian Science is constantly being disseminated in fresh quarters. The following figures may give some idea of the present strength of the movement:

The rate of increase is said to be 40 per cent per annum, with a monthly addition of 5 to 7 churches. In December, 1899, the "Christian Science Journal" gave a list of all the Christian Science churches numbering at that time about 370, distributed among 350 odd cities. In addition, there were about 100 less completely organized congregations, over 100 Christian Science reading-rooms, and 30 odd Institutes or Academies where Christian Science is taught. There are two magazines, and many publications at irregular intervals. The churches are found in nearly every State in the Union, in Canada, England, France, Germany, Australia, Hawaii and other places. Boston and Chicago, however, are the two greatest Christian Science strongholds. The Mecca of Christian Scientists is the church in Boston, erected in 1894, at a cost of over \$200,000. The expense was defrayed by subscription, and it is said that so liberal were the contributions that about \$50,000 had to be returned.

It is claimed that 1,000,000 people have received Christian

Science treatment, that the number of professed followers is 400,000 to 500,000 in the United States, and that there are as many more who are influenced by Christian Science but do not openly adopt the faith. Carol Norton claims 2,000,000 followers for Mrs. Eddy. In Maryland there are 500 actual members enrolled, and from 1000 to 1500 people who occasionally employ the Christian Science healers.

A noteworthy fact is that the ignorant and uneducated classes furnish but a small proportion of Christian Scientists, while the vast majority of them are people who have had good educations and who might reasonably be expected to think; people, moreover, who constantly come into contact with others of discrimination and at times with those of intellectual ability. Furthermore, Christian Scientists, with few exceptions, are drawn from those who can add at least a moderate amount to the wealth of the church.

Except for a very limited number of converts among the inhabitants of our jails, I have never heard of Christian Science being carried to the poor. Other observers have commented upon this fact.

The only life of Mrs. Eddy that I can find was apparently written by a Christian Scientist. She is of an old New England family and is now, according to common report, about 80 years of age and in feeble health. She is of a strongly religious temperament, and from childhood has been fond of such subjects as metaphysics, moral science, philosophy and logic. She has always been positive in her own opinions, and at 12 years would not yield her views concerning some religious tenets when she was admitted to the Congregational Church.

She was married in 1843 to Col. George Washington Glover of South Carolina, who died a year later, leaving her with one child. Her second husband was named Patterson. From him she was divorced, dropped his name, and Christian Scientists never mention him. He was her husband at the time of the "discovery" of Christian Science. Her third husband was Dr. Asa Eddy, who died in 1882.

She is said to have written extensively in prose and verse, under a nom de plume; in addition, she has written copiously about Christian Science and has composed some hymns. Her most important Christian Science writings are: "Science and Health with Key to the Scriptures," and "Miscellaneous Writings."

Mrs. Eddy was at one time a homoeopathic practitioner; she is an ardent advocate of woman's rights, has remarkable energy and zeal, and not only has the most implicit faith in herself and her mission, but inspires her disciples with the same faith.

As is natural in the case of a person so much before the public, there are unpleasant rumors as to her early life.

Common report has it that Mrs. Eddy was very poor before she "discovered" Christian Science. At present she has a palatial home in Boston; another at Concord; she has given munificently to her son, and is said to donate \$80,000 per annum to charities.

The origin of Christian Science is described as follows:

Mrs. Eddy was always a student of the Bible, but never could understand why God's healing and consoling gospel could give her no help in her sicknesses and feeble health, even though she was always religious. The answer came in 1866 at Lynn. "In company with her husband, she was returning from an errand of mercy, when she fell upon the ice, and was carried helpless to her home. The skilled physicians declared that there was absolutely no hope for her, and pronounced the verdict that she had but three days to live. Finding no hope and no help on earth, she lifted her heart to God. On the third day, calling for her Bible, she asked the family to leave the room. Her Bible opened to the healing of the palsied man (Matt. ix, 2). The Truth which set him free, she saw: the Power which gave him strength, she felt: the Life Divine which healed the sick of the palsy, restored her, and she rose from the bed of pain, healed and free. When she walked into the midst of the family, they cried out in alarm, thinking that she had died and that they beheld her ghost: this miraculous restoration dates the birth of Christian Science."

From the foregoing outline it is evident that Christian Science is something more than an empty fad; nor can we dismiss it as humbug. We must take it for what it is—a strong and growing movement, commanding the energy, enthusiasm and financial backing of a large and influential contingent of our fellow beings and working for ends that are contrary to our ideas of progress and enlightenment. What, then *is* Christian Science? What are its ideals and ideas? What rôle does it purpose to fill in the play of human life? and what is its *raison d'être*?

The following account of Christian Science is based upon Mrs. Eddy's text-book—which her disciples hold equally as sacred as the Bible, upon lectures by Carol Norton and others, and upon information very kindly furnished me by Mr. Hermann Hering, Christian Scientist of this city.

Mr. Hering has very courteously devoted considerable time to explaining to me various Christian Science doctrines, and has furnished me with all the data respecting the organization, religious customs, the Christian Science college, &c.

As its fundamental object, the text-book advances new ideas concerning the nature and origin of sin, of sickness and of death, and purposes to abolish them entirely.

The ideas concerning sin, sickness and death are corollaries to the conclusions as to the ultimate nature of God, of the human intellect and of matter.

The central thoughts of Christian Science are contained in the following quotation from the text book (p. 7):

"The fundamental propositions of Christian Science are summarized in the four following, to me, *self-evident* propositions. Even if read backward, these propositions will be found to agree in statement and proof.

1. God is all in all.
2. God is good. Good is Mind.
3. God, Spirit, being all, nothing is matter.
4. Life, God, omnipotent Good, deny death, evil, sin, disease.—Disease, sin, evil, death, deny Good, omnipotent God, Life."

To put it less epigrammatically: God is not merely the

Creator and Controller of the Universe. He *is* the Universe. Every portion of the Universe is a portion of God. God is not a personal God. To make Him personal, they say, would be to make him finite. He is conceived of as Spirit; universal Spirit, or Divine Mind.

The most difficult task in Christian Science is to obtain a clear conception of the human intellect or soul. The following quotation may serve to give the Christian Scientists' meaning of the term.

It may be prefaced that intellect, thought, will, sensation &c., are collected under the term "mortal mind"—a term frequently appearing throughout the book with various significations. To quote (pp. 9-10):

#### "SCIENTIFIC DEFINITION OF MORTAL MIND.

*First Degree:* Depravity.

*Physical:* Passions and appetites, fear, depraved will, pride, envy, deceit, hatred, revenge, sin, disease, death.

*Second Degree:* Evil disappearing.

*Moral:* Honesty, affection, compassion, hope, faith, meekness, temperance.

*Third Degree:* Spiritual salvation.

*Spiritual:* Faith, wisdom, power, purity, understanding, health, love.

In this third degree mortal mind disappears."

To put it in another way. There are two forces acting upon man. Primarily man is a part of God, is controlled by God, and all that he does is right and a part of divine harmony. But in some way—how, it is not clear—a second force begins to act. This force is defined as "*mortal mind*." This mortal mind, though endowed with powers to be stated below, has no real existence, but is only a false impression. At times this force is obedient to the Divine Mind controlling man, and acts in unison with it, but at other times, mortal mind becomes antagonistic to Divine Mind. When mortal mind is not in accord with Divine Mind, various departures from divine harmony result. These departures are not products of Divine Mind, but creations of mortal mind, and it is these creations of mortal mind that make up every ill that man is heir to. These ills are summarized as sin, sickness and death. But mortal mind does more. It is responsible for every departure from perfection that is to be found in the animal and vegetable kingdom, not only at the present day, but through all the ages. Mrs. Eddy's definition of mortal mind is (p. 583):

"Mortal Mind. Nothing, claiming to be something, for Mind is immortal; mythology; error creating other errors; a suppositional material sense, alias the belief that sensation is in matter, which is sensationless; a belief that life, substance and intelligence are in and of matter; the opposite of Spirit, and therefore the opposite of Good, or God; the belief that life has a beginning, and therefore an end; the belief that man is the offspring of mortals; the belief that there can be more than one creator; idolatry; the subjective states of error; material senses; that which neither exists in Science, nor can be recognized by the spiritual sense; sin; sickness; death."

This brings us to the Christian Science conception of matter.



Not only is mortal mind the direct cause of every evil as above described—it has further activity. The conception of God as Spirit, and of God as actually constituting the universe, necessitates the further conception that the universe is spirit; in other words, that there is no such entity as matter, and it is said that "Matter is a subjective state of mortal mind evolved in belief by false material sense" (p. 2).

The formal definition of matter is (p. 582):

"Matter. Mythology: mortality; another name for mortal mind; illusion; intelligence, substance and life in non-intelligence and mortality; life resulting in death, and death in life; sensation in the sensationless; mind originating in matter; the opposite of Truth; the opposite of Spirit; the opposite of God; that of which immortal Mind takes no cognizance; that which mortal mind sees, feels, hears, tastes, and smells only in belief."

Carol Norton, a member of the International Board of Lectureship of the Mother Church of Christian Science in Boston, Mass., says that matter is but an externalization of the human mind, and can be governed by *Mind*.

Now, starting with the conceptions that the universe is God the Spirit, and that everything else is evil and the result of the action of mortal mind, how is Christian Science to pass from the clouds of speculation to the field of practical life?

The step is simple.

No matter what may be the manifestation of mortal mind, it can always be rendered negative by creating a firm belief in the reality of Divine Mind, and at the same time just as firm a disbelief in the existence of mortal mind and its products.

The firmer these beliefs, the more completely can the manifestations of mortal mind be overcome.

What is the method by which this is accomplished?

A believer, or Christian Science Healer, sits beside the afflicted one and, as it is said, *argues* the false impression away, replacing it by the true belief. The argument, consists not in reasoning, but in the positive, confident and oft-repeated declaration of the non-existence of the disease and of the totality of Divine Mind.

This is continued as long as it is considered necessary and in addition the healer, or both patient and healer, read from Mrs. Eddy's book.

The following selections from the text-book describe the method of practice, and illustrate the Christian Scientist point of view:

(pp. 410-11) "Always begin your treatment by allaying the fear of patients. Silently reassure the patient as to his exemption from disease and danger. Watch the result of this simple rule of Christian Science, and you will find that it alleviates the symptoms of every disease. If you succeed in wholly removing the fear, your patient is healed. The great fact that God wisely governs all, never punishing aught but sin, is your standpoint, whence to advance and destroy the human fear of sickness. Plead the case in Science and for Truth, mentally and silently. You may vary the arguments, to meet the peculiar or general symptoms of the case you treat; but be thoroughly persuaded in your own mind, and you will finally be the winner.

You may call the disease by name when you mentally deny it; but by naming it audibly, you are liable to impress it upon the thought. . . . To prevent disease or to cure it mentally,

let Spirit destroy this dream of sense. . . . Argue with the patient (mentally, not audibly) that he has no disease, and conform the argument to the evidence. Mentally insist that health is the everlasting fact, and sickness the temporal falsity. . . . If the case is that of a young child or an infant, it needs to be met mainly through the parent's thought, silently or audibly, on the basis of Christian Science."

(pp. 422-423) "If the case to be treated is consumption, take up the leading points included (according to belief) in this disease. Show that it is not inherited; that inflammation, tubercles, hemorrhage, and decomposition are beliefs, images of mortal thoughts, superimposed upon the body; that they are not the Truth of man; that they should be treated as error, and put out of thought. Then these ills will disappear. If the lungs are disappearing, this is but one of the beliefs of mortal mind. Mortal man will be less mortal, when he learns that lungs never sustained existence, and can never destroy God, Who is our life. When this is understood mankind will be more Godlike. What if the lungs are ulcerated? God is more to a man than his lungs; and the less we acknowledge matter or its laws, the more immortality we possess."

(pp. 46-47) "You say a boil is painful; but that is impossible, for matter without mind is not painful. The boil simply manifests your belief in pain, through inflammation and swelling; and you call this belief a boil."

(p. 48) "When the sick recover by the use of drugs, it is the law of a general belief, culminating in individual faith, which heals; and according to this faith will the effect be."

(p. 51) "Mortal mind confers the only power a drug can ever possess."

(p. 369) "A physical diagnosis of disease—since mortal mind must be its cause, if it exists—generally has a tendency to induce disease."

(p. 411) "The daily ablutions of an infant are no more natural or necessary, than would be the process of taking a fish out of water every day, and covering it with dirt, in order to make it thrive more vigorously thereafter in its native element."

(p. 67) "When there are fewer doctors, and less thought is given to sanitary subjects, there will be better constitutions and less disease."

This may serve to give some idea of what Christian Science is. By applying these beliefs the Christian Scientist undertakes to turn the criminal to the path of righteousness, and give health and vigor to the weak and suffering, and eventually, to bring the world to a condition devoid of wickedness and disease, with a final triumph over death.

In a schematic way I have presented the essentials of Christian Science and it is evident that there are two main points of view from which it can be considered. 1. Christian Science as a religion, and a philosophy, including its application to every-day life. 2. Christian Science as a system of medicine.

#### 1. CHRISTIAN SCIENCE AS A RELIGION.

Mrs. Eddy constantly claims that Christian Science is pure Christianity; that the teachings of our Lord were only half understood by the Disciples, and that the early Christians soon lost completely the true idea of Christianity, and that it was

only through her "discovery" in 1866 that the full and true meaning of Christ's Doctrine was given to the world.

It is needless to discuss how much of Christianity their religion does, in fact, contain. It is enough to note that they believe in the one Spirit, constituting and controlling the universe and all the forces and powers therein. Moreover, they believe in Mrs. Eddy as the modern prophetess, or interpreter to man of the meanings of God. Her authority is almost absolute. Every word that she says is accepted by the Church without question as an *ipse dixit* utterance. Her position is not unlike that of the Pope's during the Middle Ages.

She is referred to as the "Mother of the Church," or simply as "Mother." Her church in Boston is called the Mother Church.

In this magnificent church there are two windows. In one window is a figure of our Lord. In the other is a representation of the woman described in Revelation: "A woman clothed with the Sun and the Moon under her feet and upon her head a crown of twelve stars." This woman, Christian Scientists claim, is Mrs. Eddy, and her text-book is the book referred to in Revelation. At intervals around the walls of this church are quotations signed alternately, "Jesus Christ," and "Mary Eddy."

In the Christian Science Church there are no ordained ministers. The readers at any church are elected by the congregation, subject to the approval of the Board of Directors in Boston. There are no grades corresponding to bishops, deacons, etc. Mrs. Eddy's own pupils, however, are looked upon as of higher authority than others.

There is no baptism, no confirmation, no giving of the sacraments at communion, and no special marriage services. The communion is celebrated twice a year, and is purely a mental or spiritual receiving of the same. There are no marriages performed in Christian Science churches except by readers who were previously ministers in Christian churches, and, therefore, by their former ministry, authorized to perform the ceremony. This is done, as a Christian Science reader told me, "So that not every Tom, Dick or Harry could marry people."

In general the government of the churches is Congregational in its outlines, that is, they are independent of each other to a large extent. But each church is controlled by Mrs. Eddy and by a Board in Boston that exercises a general supervision over the church in business, religious and legal matters.

The readings in all Christian Science churches are identical at any given service, the selections being made by the Board in Boston.

There are two forms of service: the informal experience meetings and the regular services.

The latter consist in reading selections from the Bible and from Mrs. Eddy's book and in singing hymns. At a meeting that I attended there were two readers. No. 1 read a few verses from the Bible. No. 2 then read Mrs. Eddy's interpretation of it. No. 1 then read a few more verses from a different part of the Bible, to be followed by Mrs. Eddy's interpretation, and so on. The only departure from the above routine is when a circular letter is read from "Mother to her children."

In this religion there is no thinking, no reasoning, no room for the use of the natural energies of the mind; in other words, no room for advance.

Mrs. Eddy's interpretation of the Bible furnishes the most wonderful part of the whole subject of Christian Science, for it is wonderful that anybody can take it seriously for an instant.

I do not care to comment upon the gross ignorance displayed in her derivations and interpretations, upon her vapid mysticism, nor upon her childish fondness for alliteration and cheap plays upon words; but instead I will merely read a few selections from her book:

Mrs. Eddy devotes a chapter to explaining scriptural words in terms of Christian Science; prefacing the chapter with the remark that "It contains the metaphysical interpretation of Bible terms—giving their spiritual sense, which is also their original meaning" (p. 570).

The following are a few of Mrs. Eddy's definitions:

"*Benjamin* (Jacob's son): A physical belief as to life, substance, and mind; human knowledge, or so-called mortal mind, devoted to matter; pride; envy; fame; illusion; a false belief; error masquerading as the possessor of life, strength, animation and power to act; renewal of affections; self-offering; an improved state of mortal mind; the introduction of a more spiritual origin; a gleam of the infinite idea of the infinite principle; a spiritual type; that which comforts, consoles and supports" (pp. 572-3).

"*Earth*: . . . To material sense, earth is matter; to spiritual sense, it is a compound idea" (p. 576).

"*Hiddekel* (river): Divine Science, understood and acknowledged" (p. 579).

"*Euphrates* (a river): Divine Science encompassing the Universe and man; the true idea of God"; etc., etc. (p. 576).

"*Gihon* (river): The rights of woman acknowledged—morally, civilly and socially" (p. 578).

"*Wine*: Inspiration, understanding, error, fornication, temptation, passion" (p. 589).

These selections suffice to give the general tenor of Mrs. Eddy's interpretation of the Bible.

The theology of Christian Science is not the theism of the Christian religion which looks upon God as "more than the sum of all things, but as intimately present with all things, so that all energy is an immediate manifestation of God" (Bates). On the contrary, Christian Science is almost a pure pantheism, although Mrs. Eddy vehemently denies it. Where it falls short of absolute pantheism, is in the denial of the existence of matter.

As an ethical system, Christian Science approaches more closely to the subjective idealism of Berkeley than to any other system. But it is not a subjective idealism, because it denies individuality and personality—prerequisites, of course, to Bishop Berkeley's system.

It may then be called a "Pantheistic Idealism" or an "Idealistic Pantheism." (W. B. Greene, "Christian Science, or Mind-Cure.")

In connection with this philosophy it is of interest to note that free will is impossible; that thought is precluded, for it requires mortal mind which is unreal; and that all the phe-

nomena of sense, *i. e.*, the data of universal human experience, are declared false and unreal.

There is one incorporated Christian Science college, that of Mrs. Eddy, in Boston. The other institutes, etc., where it is said that Christian Science is taught and cures effected, apparently occupy the position of primary schools of Christian Science. In the Massachusetts Metaphysical College there are three courses: one leading to the degree of C. S., the second to the degree of C. S. B., and the third to C. S. D. Each of these courses consists of a series of about 16 lectures and costs the pupil \$100. In addition, there is a course by a certain Dr. Baker, a regular practitioner, who is a convert to Christian Science. Dr. Baker gives a shorter course, *i. e.*, less than 16 lectures, in which he undertakes to teach to the senior grades some practical medical procedures. This course consists entirely of lectures without any hospital or laboratory training.

In their every day life Christian Scientists drop, to a great extent, their belief that matter is non-existent and a false belief of mortal mind. They eat, dress, live in houses, walk through doorways instead of theoretically non-existent brick wall, and in general live the same life, subject to the same conditions as the most materialistic of us.

While they assert that all the data of human experience in relation to the outside world are false, and no more true and actual than are dreams, still, they consider it best, under the present circumstances, to accept things as they are. Accordingly, they approve of education—even of advanced education—in history, philology, sociology, and even in some of the sciences. They positively refuse to have any dealings with the biological sciences, or with anything that gives a knowledge of the structure or action of the human body, of the action of drugs, or of the study of diseases. They say that the more these subjects are studied the more impossible it is for the student to acquire the proper belief in the totality of Divine Mind and the falsity of matter, disease and death.

Upon the problems of death and the origin of life, I cannot make clear to you the Christian Science views. To questions that I asked upon these points, I was told that it required years of study of Mrs. Eddy's system in order to arrive at a correct understanding. The stumbling-block with me is briefly set forth. In the first place, as all Christians believe in the immortality of the soul, that question need not be considered as a special Christian Science problem, and it only remains to deal with the body. Can Christian Science save the body from death? Now, Christian Science states that there is no body, but only a false belief—a belief, moreover, which can be and is to be obliterated. If the body is obliterated, how is Christian Science to save it from death? It reminds one very much of the grin without the cat that surprised Alice in Wonderland.

Similarly with the origin of life. Every new individual born is only another false belief. But in a natural state each individual is a part of Divine Mind. How, then, does Divine Mind, which denies evil, come into association with this false belief? It is another way of putting the question suggested earlier in this paper: If the original man is part of All Good, as Christian Scientists tell us, having no activity nor volition,

except from Divine Mind, how can the evil mortal mind originate? This has never been explained, so far as I know.

Let us now consider

## 2. CHRISTIAN SCIENCE AS A SYSTEM OF MEDICAL PRACTICE

At the outset we are met by the question just considered. If the body is a false belief, and sickness is a false belief, what would be the effect if the patient returned to a condition of harmony with Divine Mind? Why should not body be nullified as well as sickness?

Christian Science denies the utility of medical knowledge and medical methods, and refuses to use drugs, surgery or any therapeutic agent other than Divine Mind. The study of any medical science is reprehensible. They abhor diagnosis, for Mrs. Eddy says that the diagnosis of a disease tends to bring on the disease. They utterly disapprove of hygiene, cleanliness, antiseptics, vaccination, the isolation of contagious diseases, and, in general, of all those methods ordinarily considered useful in the prevention and relief of disease. They undertake to cure every form of disease by inducing the patient to disbelieve in its existence and acquire faith in their God. Not only do they undertake to cure adherents of the system, however, but also non-believers; that is to say, a person who does not believe is cured by his belief.

The method employed has been described above.

Mr. Hering says that he has had about 80 per cent of cures, including those cases given up by regular practitioners. This percentage is almost surely incorrect. The Rev. Oliver Huckel estimates that 5-15 per cent are cured in Christian Science.

The reasons for supposing that Christian Scientists claim more cures than they effect are the following:

1. They keep no records of cases and, therefore, cannot note accurately what changes occur in the patient.
2. They make no diagnosis of disease, and, therefore, there is no assurance that they have treated the diseases claimed.
3. They make no examination of the patient after treatment, and, therefore, there is no proof that they have effected the cure claimed.

Dr. Huber, in New York, had a chance to examine some "cures" and found absolutely no basis for their claims. All attempts to get proofs of their good results have failed. Mr. Purrington attempted to get them from Mr. Carol Norton. The proofs consisted in short statements by the Christian Science healers.

There is, however, no doubt that a certain number of cases recover. These recoveries depend upon two chief factors:

In the first place, as is well known, the majority of sick people recover without, or in spite of, treatment. This is a well-recognized fact. Such cases are regarded by Christian Scientists as cures due to their methods. The second factor is undoubtedly the method employed by Christian Scientists. The cures from this are, in all probability, but a small proportion of the whole.

Now, the important question is: What is their method? Have they added anything new to the stock of medical



knowledge? I think there can be no doubt that they have not.

In spite of the most vigorous denials by Mrs. Eddy: in spite of the most solemn assurances from Mr. Hering that I do not understand the case; I can not escape from the conviction that the only therapeutic agent at work in Christian Science is mental suggestion. The fact that the healers and patients are firmly convinced that each cure is a divine manifestation, does not weaken, but indeed supports this idea. The reasons for this conclusion are numerous:

At one time Mrs. Eddy was a homoeopathic practitioner and employed the greatly diluted preparations of that cult. She found that she could obtain just as good results by giving no drugs as by using the weak drug. This put her on the track of Christian Science, and this is nothing in the world but pure mind-cure, or mental suggestion. Moreover, she constantly illustrates the action of Christian Science by references to this feature of homoeopathy.

Secondly, Mrs. Eddy was at one time under treatment by a Dr. Quimby, who employed hypnotism. Her text-book appeared about a year after his death.

The strongest evidence that Christian Science is mental suggestion with a different name is furnished by her method of employing it. The patient is told to be calm, and is assured that all will go well; that he must try to aid the healer by believing that what is told him is true. The healer then, quietly, but firmly asserts and reiterates that there is no pain, no suffering, that it is disappearing, that belief will come, that the patient is getting well. As an aid to render the patient more susceptible, an appeal is made to that most potent agent, religious fervor.

If the name were not given, one would suppose that the description was not of Christian Science, but of hypnotism. It is not improbable that the subjects are, at times, actually hypnotized.

The Rev. Mr. Huckel's statistics also are in favor of the mental quality of Christian Science healing. He finds that Christian Science has about the same percentage of cures that are effected by other mind-cures, as at the various Catholic shrines; by avowed mind-healers, and in the cases treated with bread-pill medicines.

There is no point upon which a Christian Scientist is more emphatic than in denying that Christian Science healing is due to mental suggestion. According to Mrs. Eddy, Carol Norton and those Christian Scientists with whom I have conversed, the healing is effected not at all through mental suggestion, not through any miraculous intervention, involving a departure from the normal course of nature, but by the natural, ever present action of the Divine Mind. The cures of Christ (which they deny were miraculous) were of the same character.

Healing, as they practice it, is not only the privilege of every Christian; they claim that Christ has made it a duty for every one of his followers to "heal the sick" (Matt. x. 8), a duty as binding as any other Christian observance.

There is one feature of Christian Science healing that I have delayed mentioning, because I wanted to give it especial prominence, that is, the Christian Science treatment of

children too young to be given the "argument treatment" as it might be called.

Incidentally it may be noted that the same treatment is employed to cure children, animals and plants.

The Christian Scientist goes upon the assumption that, if the child is too young to have false beliefs himself, any illness that may overtake him is the result of false belief on the part of his parents or of those in charge of him. Therefore, when summoned to attend a child the Christian Scientist pays absolutely no attention to the child, but proceeds to convince the parents that there is nothing the matter with it; that there is only a wrong belief in their minds which they must dismiss if they wish the child to recover. This is the only treatment given. No matter (as has happened) if the child is suffocating with diphtheria, no matter if he is suffering from the most fatal digestive disturbances, no matter if he is racked by whooping-cough, or covered with the eruption of scarlet fever, the treatment is the same. In no case do they recommend any medicinal treatment, nor attempt to alleviate in any way the infant's distress. And all this, in the name of Religion!

Let us now look at Christian Science as a whole. We see that the head of the movement is a woman, who is considered by some to be the victim of a form of insanity, known as paranoia; a woman whom many more consider simply an impostor, growing rich at the expense of her deluded followers; a woman evolved from homoeopathy, who claims the powers of Divinity.

We see that this woman has built up a system showing the utmost crudeness of construction, full of inconsistencies and self-contradictions; displaying, at every turn, the author's ignorance of the meanings of words, her confusion of ideas and complete inability to reason logically. We see the head of this system guilty of horrible blasphemy. We see her denouncing as false the findings of all human experience, and we see her arrogantly vaunting herself as the only human being with true knowledge, and on every page of her book boasting of her superior wisdom. We see the members of this school making the most extravagant claims of their power over disease; we see them, in the name of religion, stand passive at the bedside of suffering infancy; we see them, in the name of religion, attempting to undo all that has been accomplished by millions of earnest workers and thinkers to better the conditions of human life.

On the other hand, we see this sect growing like a mushroom. We see that thousands of rational people accept Christian Science *in toto*; that it numbers among its followers judges, lawyers, doctors, ministers, business men and people of all classes. We see them devoting to it their time, their enthusiasm and their money. We see people, whom it would be ridiculous to call insane, refusing any other assistance in their most serious illness and relying upon the efficacy of Christian Science to save their children from the grave.

How can we account for this curious condition? What gives Christian Science its strength? Is there any way in which to explain its existence?

If we try to account for the immense following of Christian Science and its strength by the intrinsic merits of its teaching

and work, we must remain unsatisfied on account of the insufficiency of motive.

Christian Science appears to have no points in its favor that are original or peculiar to itself. The idea that disease is a work of evil, or—in the Christian Scientist's nomenclature—of mortal mind, is as old as history. This idea of sin as a work of the devil, is seen in the histories of all the ancients; it occurs in the Bible; it was the thought that prompted the treatment of insane people in the olden times when they were put in mad-houses and frightfully abused in order to drive out the evil spirit, and it is not an uncommon thing to see evidences of the same idea nowadays.

Again, the most attractive feature of the Christian Science religion is the manner in which they insist upon the healthfulness and necessity of cheerfulness, composure and self-forgetfulness. Their religion teaches them to forget their own sufferings and distresses and to take an interest in outside things.

But this cannot account for the strength of Christian Science, for this is not a new doctrine. The same thing is being brought more and more to the front as an essential part of personal religion by the churches throughout the land.

Again, the only idea brought forward by the medical teaching is the efficacy of mental suggestion as a therapeutic agent. But this is by no means new. There is no one who denies its utility; it is employed, consciously or unconsciously, to a very wide extent, while one branch of it—hypnotism—is steadily growing in importance as a therapeutic agent.

But if we cannot find the *raison d'être* of Christian Science in its intrinsic qualities, how is it explicable?

This brings us to the consideration of a curious phenomenon presented by society. It is a phenomenon that has occurred from time to time since the foundation of society, and consists in the rise and enormous popularity among reasoning people of ideas that are utterly irrational, or contain but a grain of reason. It is the same phenomenon illustrated by the original spread of homoeopathy, of Thompsonianism, of Perkinism, of theosophy, of Schlatterism, and by the history of many more popular fallacies, either defunct or passing.

I regret that I can do no more than touch upon this subject. There are certain factors that may be considered to afford a particularly fertile field for the growth of Christian Science.

In the first place, there is always an element in the community whose tendency is to go to extremes in adhering to their ideas. A person of this class, being convinced of the truth of that portion of Christian faith which teaches the universality of God, will apply his belief blindly to every case, without regard to any evidence that fact and reason may oppose.

Secondly, the great improvements in the material comforts of modern life and, also, the great development of the natural sciences, with their rigid demonstration of material origin and causation, are (at least in part) responsible for the materialism that so widely pervades modern thought. It is only natural that there should be a reaction from this materialism and from its causes, to the extremes of idealism.

In the third place, there are always people eager for something new, seeking for miracles and ready to believe it possible

to obtain that complete mastery over nature, that Faust despaired of acquiring after a life of endeavor.

The chief basis for the growth of Christian Science, however, is the same that underlies every popular pseudo-science. Oliver Wendell Holmes outlines very clearly the factors concerned, showing (a), how easily abundant facts can be collected to prove anything whatsoever; (b), how insufficient, "exalted wisdom, immaculate honesty and vast general acquirements," are to prevent an individual from having the most primitive ideas upon subjects out of his line of thought, and, finally, demonstrating "the boundless credulity and excitability of mankind upon subjects connected with medicine."

The same conditions referred to in Holmes' essay are responsible for Christian Science. Furthermore, Christian Science is partly a religious mania (though the title of the text-book shows the relative importance of its medical and religious doctrines).

A further source of strength in Christian Science is the confidence with which the teacher assures her followers that they are the only profound thinkers in the world, and makes them believe that the adoption of her ideas is a mark of superiority separating them from the ordinary masses.

Such being the status of Christian Science, what may we conclude as to its future?

There is no doubt that the only grain of truth that supports Christian Science is its employment of mental suggestion. It is probable, also, that mental suggestion has a much wider field of application than it receives at present. It is not improbable, I think, that, as regular practitioners develop the possibilities of suggestive therapeutics more and more, they will cut away the only prop that can hold up Christian Science; though it will almost surely disappear even without such deprivation.

It is really no stretch of the imagination, to predict that our generation will see the decadence of Eddyism and the rise of another pseudo-science just as impossible as Christian Science, and just as powerful.

Christian Science is very shrewdly planned to give it the strongest and most permanent foothold possible. The regulation, limiting the right to perform the marriage ceremony to the converted ministers from other churches illustrates this, and features of their medical system serve as better illustrations.

In the first place, although they claim to cure all diseases, Mrs. Eddy advises them not to deal with surgical cases. The reason for this is obvious. The good or bad results of treatment in surgical cases, as for instance fractures, are much more evident to the ordinary person than are the results from medical diseases, as typhoid fever; and bad results in such cases would lay the Christian Scientist open to prosecution in court. Again, Christian Scientists, when called in to treat cases, profess the utmost willingness to allow regular practitioners to be summoned (though they advise their followers of the wickedness of such procedure); they refuse to charge fees for services rendered (though Mrs. Eddy has stated that "Christian Science demonstrates that the patient who pays whatever he is able to pay for being healed is more apt to recover than he who withholds a slight equivalent for health") (Miscel-

laneous Writings): they give no remedies nor medical advice: for that would subject them to prosecution. And, finally, they claim that they themselves are not the effectors of cures, but the agents of God, and that to interfere with their medical practice is to interfere with their freedom of conscience, and right to pursue their religious teachings.

In concluding, I must state what seems to be the proper attitude for us to hold towards Christian Scientists.

There are really not many active measures that we need adopt toward this cult. The most rapid and efficient means of destroying them is to bring prominently before the public the manifest absurdities of the school, and the dangers attending its spread. Severe measures would tend to strengthen their hold by putting them in the position of persecuted martyrs. There are, however, three points, that it is well to aim at in dealing with them.

1. To insist that they report to the Health Department all births, deaths and contagious diseases, and that, in the latter class of cases, they take proper means to protect the community.

2. To secure for small children the proper protection from Christian Science extravagances.

3. The third point is too big to be more than touched upon here, and deals with the regulation of medical practice in general; but, in brief, we should attempt to limit the right

to treat the sick to those who have given satisfactory evidence that they possess a knowledge of the conditions of health and disease, and who can show that they have the requisite training. These objects are to be attained by legislation to debar the ignorant from practice, and by prosecuting in the courts those who practice without the proper qualifications.

This is a very important question, and one that has been brought to the front already. There are numerous cases in which Christian Scientists have been prosecuted in various States, but up to the present they have escaped either upon the ground that they were not medical practitioners, but were simply meeting the demands of their religion, or upon a defect in the statutory definition of what constitutes the practice of medicine. Upon the first of the points the Supreme Court of the United States has declared that no one can violate the law under the cloak of religion.

The usual defect in the statutory definition of medical practice is that the giving of drugs or other medical treatment is considered necessary to make a person a practitioner, and Christian Scientists use no medical measures.

The questions involved here with a list of cases is very fully considered in a recent book by William A. Purrington, of New York.

## TWENTY-FIFTH ANNIVERSARY OF DR. WELCH'S GRADUATION.

On the evening of May 4, Prof. Councilman of Harvard University, in behalf of the students and coworkers of Dr. Wm. H. Welch, at a complimentary dinner held at the Maryland Club, Baltimore, presented him, in honor of the twenty-fifth anniversary of his doctorate, a volume of contributions to the science of medicine, containing 38 papers, all embodying original research. (See page 138.)

### ADDRESS OF PROFESSOR W. T. COUNCILMAN.

On this occasion, 25 years after your entrance into the medical profession, we, your students, present to you this volume. It contains a number of articles written by us, each of which contributes to the advancement of medical knowledge. We have chosen this method to tell you of our esteem and affection, for we feel that it is the highest and most enduring tribute we could lay before you. For, unlike any tribute wrought in stone or metal, it has the quality of increase. The results of the investigations here set forth will stimulate further investigations and lead to still greater increase of knowledge. It is the work of men you have taught, who have come under your influence and who have received from you the inspiration which has enabled them, often amid great difficulties, to continue in the path along which you first led them.

It is one thing to tell a man what is the right way; it is better still to show him; but it is quite another thing to take him by the hand and lead him along it. This you have done, and it is this which has made you the great teacher which you are, for a teacher to be great must be a leader among men. You have taught us what is known. In your lectures you have presented to us, with a clearness that has never been surpassed,

the known facts of medical science and the deductions to be drawn from those facts. We have learned from you the importance not of theory, but of definite knowledge. You have further showed to us that merely to acquire what is known is not the true aim, but that he who would himself advance and contribute to the advancement of his fellows must seek to enlarge the bounds of knowledge. By your own work you have led us. The importance of the work you yourself have done is recognized by the world. It has been marked by your characteristic clearness, thoroughness and fairness. In the work which you have inspired, there has been absolute freedom in the worker. You have always sought to turn their investigations into the development of truth.

The work has been in a broad field, and the workers have had a clear sky above and fresh breezes around them. All branches of medical science have been enriched by this work. The breadth of the work is shown in the subjects treated in this volume. We feel that you are a part of it, that our work is due to your inspiration. But your work as a teacher and leader has not been confined to those who have felt your presence; it has been far wider. Your influence has been felt in every part of the country, because each man who has gone from you has been a missionary burning to lead others into the light.

One year after your graduation, The Johns Hopkins University opened its doors. The central idea of the university, the idea with which it started, which distinguished it from other institutions of learning in this country at that time and gave it at once its high position in the world, is that it is the duty of a university both to impart knowledge and to increase knowl-



edge by original research. In the medical education at that time there were no high ideals. There were numerous schools in which the medical art was taught, but in no place had the university ideal, which aims at the advance of knowledge, entered into medical education. Not that there were not a few great teachers, but the principle was not there.

The creation of the Medical School of the University was slow. First physiology and then pathology were established as departments of the university. Sixteen years ago, Dr. Welch, you were called to the chair of pathology in the university. There was no hospital to furnish material, no students to teach. You began your work, and before the hospital was opened you had grouped around you an earnest band of workers. Those of us whose fortune it was to have been with you in those early days can never forget them.

When the Medical School was opened, the ideals of the university had been established in its most important departments and were a controlling power. There sprang up at once that close union between the university and the medical school to which, more than anything else, the marvelous growth and influence of the medical school has been due. The medical school was founded in the laboratories of physiology and pathology. There has been in the medical school and in the hospitals a close union between art and science, an appreciation of their mutual dependence, which in its fullness was new to America.

We have ourselves tried to do what we could to advance knowledge and to extend to others the ideals which we learned from you. Your spirit lives in us, and we extend to you in this work the best expression of our affection, our esteem and our gratitude.

#### ADDRESS OF PROFESSOR WELCH.

On accepting the volume, Dr. Welch replied as follows:

*My friends and fellow students:*—I have no words adequate to express my appreciation of this demonstration of your affection and loyalty. With a heart full of thanks I accept this magnificent volume of contributions to medical science by my pupils and coworkers, now and in the past.

I thank you, Dr. Councilman, for your generous words in presenting this volume, even if I must believe that your estimate has far exceeded my merits. Although I have been kept in ignorance of the details of this undertaking, I know that my especial thanks are due to Dr. Mall and Dr. Flexner for its inception and conduct, as well as for the incentive to several of the contributions. Turning the pages, I see how much is due to the marvelous artistic skill of Mr. Broedel, and I am not surprised to hear of the unselfish devotion of Dr. Hurd in the editorial work, nor that my old friend and colleague, Dr. Halsted, has been active in arranging for this occasion. To all who have honored me by their contributions to this volume I am deeply grateful, and the kind messages from many other pupils and associates have gladdened me.

Nothing could afford me livelier pleasure and satisfaction than to have my name associated in this way with a volume of contributions, which cannot fail to interest all workers in scientific medicine. I recognize among the contributors not only the names of those who have gained distinction as inves-

tigators, but also of those who are beginning their careers and will now win their first spurs. To me the most significant feature of this occasion is that the time has come in America when a group of investigators, more or less closely connected through common teachers, can bring together so large a number of important, original contributions to medical science. Twenty-five years ago this would not have been possible. That I should have been permitted to participate with others in bringing about this advance is to me a source of much gratification.

When Dr. Prudden and I first started our small laboratories in New York, he at the College of Physicians and Surgeons, and I at the Bellevue Hospital Medical College, the outlook was not encouraging for a young man to select pathology for his career. The contrast between then and now in this respect is indeed a striking one. To-day, pathology is everywhere recognized as a subject of fundamental importance in medical education and is represented in our best medical schools by a full professorship; at least a dozen good pathological laboratories, equipped not only for teaching but also for research, have been founded; many of our best hospitals have established clinical and pathological laboratories; fellowships and assistantships afford opportunity for the thorough training and advancement of those who wish to follow pathology as their career; special workers with suitable preliminary education are attracted to undertake original studies in our pathological laboratories; students are beginning to realize the benefits of a year or more spent in pathological work after their graduation, as a foundation for future success in practical medicine, surgery, or the specialties; and as a result of all these activities the contributions to pathology from our American laboratories take rank with those from the best European laboratories. While we realize that we are only at the beginning of better things and that far more remains to be accomplished than has been attained, nevertheless, the progress of pathology in America during these twenty-five years has surely been most encouraging.

When I look back over this quarter of a century I realize how favored I have been by my opportunities, and here you will permit me to be somewhat personal. My interest in pathologic anatomy was awakened in my student and hospital days by Delafield and Janeway, who are among the best pathologic anatomists whom I have ever known. I received also a strong stimulus toward scientific work from Jacobi, whose seventieth birthday will be celebrated to-morrow night in New York by well-earned honors. I owe more than I can tell you to my teachers in Germany, to Cohnheim, Weigert, von Recklinghausen and Wagner, and through them to the great master, Rudolph Virchow. Upon my return to this country, my association with Dr. Austin Flint, the elder, was to me an inspiration, and in many ways of the greatest advantage.

While the prospects for earning a livelihood and for advancement in a pathologic career may not have seemed encouraging in New York, 22 years ago, in reality the circumstances were fortunate. About that time there were introduced great improvements in histologic technic, which led to a deeper insight into the structure and activities of cells and opened the way for new directions of development. Above all, it was the begin-

ning of the bacteriologic era marked by the great discoveries of Koch, of whose earliest work I saw something while studying in Cohnheim's Laboratory in Breslau, and whose personal teaching I later enjoyed. To have begun one's work as a teacher of pathology at such a period and after intercourse with such masters of the science, and to have been permitted to continue it during these years of unparalleled progress, must be considered a circumstance fortunate for the teacher.

The time was fully ripe in this country for the introduction of laboratory teaching and investigation in pathology, and it is certain that if one had not appeared to undertake it, another would have done so. It was an easy matter under such circumstances to demonstrate the value of the pathologic laboratory in medical education. I have every reason to feel grateful for the encouragement and support accorded the little laboratory at Bellevue College and the opportunities there afforded to me. Prudden's Laboratory, founded about the same time at the College of Physicians and Surgeons, has developed under his masterly direction into a large and splendidly equipped laboratory, surpassed by none in its influence upon the advancement of pathology in this country. I need not speak here of the wider opportunities, so well known to you, which I found in Baltimore, of the liberal policy of the Trustees of The Johns Hopkins University and Hospital in the establishment and support of the Pathological Laboratory, of the advantages derived from the intimate association of the Medical School with this great University and Hospital, of the stimulus received from my colleagues, and of the attraction of our high standards of education in drawing to us highly trained students.

Above all, most fortunate have I been in those who have worked with me as pupils and associates, and to these co-workers is due in the first instance whatever of success has attended my efforts as a teacher and student of pathology. I am delighted to see here to-night my old friend and co-worker in the New York Laboratory, Dr. Meltzer, and also Dr. Beyer. To have had such a coadjutor in the early organization and conduct of the Baltimore Laboratory as Dr. Councilman, such an original investigator as Dr. Mall for the first fellow in pathology, such special workers in the early days of the laboratory as Sternberg, Halsted, Herter, Abbott, Bolton, Nuttall, Booker, Miller, Barkley, Clement, Howard, Russell, Blachstein, Thomas, Williams, Randolph, Gilchrist, and others—all of this I count as the best of good fortune. I call to mind on this occasion with affectionate regard many others who have followed these earlier workers, but the list is too long to enumerate. I must, however, give expression of my indebted-

ness to Dr. Flexner, who since the opening of the Medical School until the end of the last academic year has been my closest associate in the work of teaching and in the supervision of the laboratory.

While it has been hard to part with such associates, it is a matter of pardonable pride that so many have been called to important chairs in other institutions—Councilman to Harvard; Abbott, Flexner and Clark to the University of Pennsylvania; Wright to the Laboratory of the Massachusetts General Hospital; H. U. Williams to the University of Buffalo; Blumer to the Bender Hygienic Laboratory in Albany; Bolton to the Hoagland Laboratory and subsequently to other institutions; Howard to the Western Reserve University; Nuttall to the University of Cambridge, England; Russell to the University of Wisconsin; and now we are to lose Barker, most scholarly, versatile, inspiring of teachers and profound in his studies, who has been called to an important position in the University of Chicago. That we shall retain with us young men of great promise is evidenced by such contributions as those of Cullen, Cushing, Young, Bardeen, the MacCallums and Opie in this memorial volume. I rejoice to see in this book in connection with Cushing's, the name of our much-loved Livingood, whose career of unusual promise was cut short by an ill-timed fate.

I should like to be able to speak of the value of the contents of this volume which you have dedicated to me, but I see it for the first time to-night. A glance through the pages assures me that here are gathered together papers with which any medical teacher in the world would be proud to have his name associated. I may be permitted to call attention to the importance of the contributions from our women students; and it will not, I trust, be invidious if I mention the superb work of Miss Florence Sabin, done under Dr. Mall's and Dr. Barker's direction, and so beautifully illustrated by Mr. Broedel.

As I have already said, I see in this volume of studies an index of the great advance during the last quarter of a century in the material conditions surrounding pathological teaching and investigation in this country, brought about especially through the establishment of laboratories. It is also a significant token of the greater things which we may assuredly expect in the future, when America will take her place in the front rank with those countries which contribute most to the progress of the medical and biological sciences. If my name shall ever be mentioned among those who in those earlier days have helped to promote our science in this country, I shall owe it above all to you, my pupils, colleagues, and fellow workers.

## MONOGRAPHS.

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# CONTRIBUTIONS TO THE SCIENCE OF MEDICINE DEDICATED BY HIS PUPILS TO WILLIAM HENRY WELCH ON THE TWENTY-FIFTH ANNIVERSARY OF HIS DOCTORATE.

## TITLES AND ABSTRACTS.

### I.

**A Contribution to the Study of the Pathology of Early Human Embryos.** By FRANKLIN P. MALL, Professor of Anatomy, Johns Hopkins University. With 6 plates and 29 figures in the text. (Pages 1 to 68.)

The paper is based upon the study of 50 pathological human ova which have been collected by the author during the past six years. Nearly all of the embryos were cut into serial sections, thus permitting of a more careful study than is possible from that of the external appearances alone. As far as possible, additional data were obtained from the physicians from whom the specimens were obtained, and these prove to be of much value.

The paper discusses the following subjects:

1. Arrested development of the embryo with continued growth of the ovum.
2. Degeneration of the embryo, leaving only the umbilical cord.
3. Ova, normal in form, without embryos and uterine moles.
4. Vesicular forms of pathological embryos.

It is followed by an appendix giving the main data of all of the normal embryos known as well as a detailed description of each of the pathological specimens discussed in the communication.

### II.

**On Urea in Some of its Physiological and Pathological Relations.** By C. A. HERTER, Professor of Pathological Chemistry, University and Bellevue Hospital Medical School, New York. (Pages 69 to 109.)

The physiological portion of this paper deals (a) with experiments which were undertaken with a view to comparing the capacity of different types of kidney in the excretion of urea, and (b) with the experiments relating to the nature of the cell activity concerned in the excretion of urea.

The pathological section is devoted to a record of experimental observations on the following subjects: (a) the toxic action of intravenous infusions of watery solutions of pure urea, especially in dogs and monkeys, (b) the action of urea upon experimentally damaged kidneys, (c) double nephrectomy and its effects upon the urea content of the blood, muscles, liver and brain, (d) insufficiency of urea in the course of renal disease, (e) the relation of an excess of urea in the blood (literal uræmia) to uræmic states. Evidence is brought forward in this section of the paper which indicates that a large excess of urea in the blood is capable of giving rise to disturbances which manifest themselves clinically, although in some examples of conditions included by clinicians as uræmic it is quite clear that urea can play no part in occasioning the symptoms.

### III.

**The Direct Action of Nicotin upon the Mammalian Heart.** By HENRY G. BEYER, M. D., Surgeon U. S. Navy. With 9 figures in the text. (Pages 111 to 134.)

This paper gives an account of some experiments made upon the isolated heart of the cat with nicotin in blood in different degrees of strength; it also describes the effects of nicotin on the dog's apex on which two experiments were made; finally, several experiments are recorded in which nicotin in blood was allowed to run through the coronary vessels while the heart was in a state of fibrillation.

The experimental evidence brought out seems to warrant the following conclusions, namely:—(1) Nicotin acts as a powerful stimulant on the vagus nerve endings as well as on the accelerator or augmentor nerve endings in the heart; (2) it increases both the tonus and the irritability of the muscular fibres of the heart and, lastly, causes the contraction of the coronary vessels.

### IV.

**The Effect of Shaking upon the Red Blood-Cells.** By S. J. MELTZER, M. D. New York. (Pages 135 to 151.)

The conclusions reached are as follows:

1. Shaking of even a very short duration has a detrimental effect upon the red blood-cells, which manifests itself by an early separation of the hæmaglobin followed by a rapid breaking down of the stromata into dust.

2. The process of defibrination is invariably very injurious to the life of red blood-corpuscles.

3. Prolonged shaking of the blood with a granulated insoluble substance turns the red blood-cells into fine dust. Cells of different animals show different degrees of resistance. The destruction is due to a molecular shock and not to a gross injury. The continual shaking beats together again the fine dust into large granules and dust. Possibly the molecular destruction is characteristic of organized elements.

4. Certain degrees of shaking can also prolong the life of the red cells, but the degree which is favorable to the life of the cells of one species of animal may be detrimental to the cells of another species.

These relations present a special instance of the general law formulated by the writer for the relations of vibration to all living organisms; for each individual form of life there is a minimum degree of vibration which is indispensable and another degree which presents the maximum limit.

### V.

**The Blood-Vessels, Angiogenesis, Organogenesis, Reticulum, and Histology of the Adrenal.** By JOSEPH MARSHALL FLINT, Baltimore. With 8 plates and 28 figures in the text. (Pages 153 to 228.)



The adrenals are situated in what may be termed the vascular crossroads of the abdomen, for within a few centimetres of them the large trunks which supply almost all of the abdominal viscera are given off. Most of these contribute to the circulation of the glands which may be divided into three systems of vascular units, supplying respectively the capsule, cortex and medulla. In the capsule, there is an arterial and a well marked venous plexus. From the former the branches which supply the entire organ are derived. The blood-vessels of the cortex consist in the main of parallel capillaries with transverse anastomoses which empty into the venous tree of the medulla; while the arteries supplying the medullary substance pass entirely through the cortex to ramify in the medullary portion of the gland, giving off in their course arterioles and capillaries which empty finally into the branches of the venous tree, or into medullary veins which join them. The venous tree itself flows into the lumbar vein at the hilus of the gland.

This complex vascular system, following partially known laws, can be traced by means of injected embryos in its gradual evolution from the simplest to more complex stages, until finally the adult arrangement is reached. Curiously enough, the medulla is developed outside of the cortex and grows into it after the latter is well formed, the various steps in this transposition being beautifully shown in stained or injected adrenals of embryo pigs. Of especial interest is the fact that simple mechanical misplacements may lead to anomalies of structure in the adult gland, occurring during the migration of the medulla, which are unintelligible in the adult organ unless viewed in the light of their formation.

The framework of the adrenal is made up of reticulum which can be studied best by some of the destructive methods. The reticulum fibrils have a definite arrangement in relation to the cells and blood-vessels, which they support and hold in position. Finally, the architecture of the adrenal is described most fully from the conditions found in the dog, where such variations of structure as transposed cortex or misplaced medulla are explained by the ingrowth of the medulla as followed in the organogenesis of the gland in a series of embryo pigs.

#### VI.

Specific Degenerations of the Cortical Arteries. By HENRY J. BERKLEY, M. D., Clinical Professor of Psychiatry, The Johns Hopkins University. (Pages 231 to 236.)

#### VII.

The Regeneration of the Crystalline Lens. (Alvarenga Prize Essay, 1899.) By ROBERT L. RANDOLPH, M. D., Baltimore. With 6 figures in the text. (Pages 237 to 263.)

The subject attracted the attention of investigators seventy-five years ago. Since then several have busied themselves with the problem, but within the past thirty years nothing of note has appeared in connection with it. It is surprising to see that a histological problem of such importance finds no mention in either works on anatomy or ophthalmology. The object of this work is to ascertain whether the lens of the rabbit is regenerated after its extraction—whether, in other words, a new lens is formed. The conclusions are as follows:

1. Regeneration of the lens in the rabbit's eye occurs *only when some portions of the lens are left behind at the extraction.*
2. Removal of the lens in capsule is followed by a negative result.
3. Panophthalmitis is followed by a negative result.
4. The volume of the regenerated lens may be equal to that of the original lens.
5. The regenerated mass is lenticular, though sometimes it is ring-shaped and at other times it is semilunar.
6. The reason why positive results occur so much less frequently than negative ones, is because we are unable to protect the animal from infection after the operation.
7. Theoretically one would suppose that the longer the animal were allowed to live the greater would be the volume of the regenerated mass. This, however, was not the case in these experiments. In one instance where an animal was killed fifteen months after the extraction of its lens, the regenerated lens was about equal in size to that seen in another case where the rabbit was killed after six weeks. It may be added that there was no apparent reason for this.
8. A *mild* iritis, lasting for a week or ten days after the operation, is conducive to a successful result. This may be explained by the increased vascularity of the parts which lie next to the lens.

The second portion of the paper is devoted to a consideration of the works of Wolff and Erik Müller. The former made the statement that the lens of the triton (salamander) is regenerated from the iris epithelium and Müller confirmed Wolff's results. The author made fresh observations and reaches the following conclusions: 1. In the case of the newt, extraction of the lens is followed by its regeneration. 2. Regeneration occurs even when the lens has been removed in its capsule, so that the new lens must take its origin from tissue having a different physiological value; and, as the experiments of Wolff have shown, this structure is the iris.

#### VIII.

The Histology of Acute Lobar Pneumonia. By JOSEPH H. PRATT, M. D., Boston. With 1 plate. (Pages 265 to 277.)

Early in the disease the alveoli contain many cells almost identical in appearance with the so-called transitional cell of the blood. They are usually slightly larger than the polynuclear leucocyte, and contain an irregular vesicular nucleus, surrounded by a rim of protoplasm, containing either a few granules or none at all. In a case in which death occurred eleven hours after onset, there were great numbers of these cells in the exudate and no polynuclear leucocytes.

Large phagocytic cells are found in all stages of the disease, but in greatest number in gray hepatization. The inclusions consist chiefly of polynuclear leucocytes and lymphocytes, more rarely of red blood-corpuscles. These phagocytic cells probably play an important part in resolution. Similar cells are found in the lymphatics, in the pleural exudate, and in the bronchial lymph nodes.

The fibrin is not formed by a degeneration of the alveolar epithelium, but comes exclusively from the exuded blood plasma.

The lymphatics are involved late in the disease. There is proliferation of their endothelium, and they become distended with cells, serum and fibrin.

Early in the disease there is no infiltration of the interstitial

tissue. In cases dying during the second week, there is often a great infiltration with lymphoid and plasma-cells. As a rule the longer the duration of the disease the greater the number of plasma-cells.

These results are based upon a study of fifty cases of typical lobar pneumonia.

#### IX.

Bilateral Cholesteatomatous Endotheliomata of the Choroid Plexus. By GEORGE BLUMER, M. D., Director of the Bender Hygienic Laboratory, Albany, N. Y. With 1 plate. (Pages 279 to 289.)

#### X.

Concerning the New Formation of Elastic Fibres, Especially in the Stroma of Carcinomata. By HERBERT U. WILLIAMS, M. D., Professor of Pathology and Bacteriology, Medical Department, University of Buffalo. (Pages 291 to 296.)

Our knowledge of the condition of the elastic fibres in normal and pathological tissues has recently been much improved by the discovery of selective staining processes. Weigert's method was used by the writer with most satisfactory results. A review of the literature of the subject shows that newly formed elastic fibres have been found in the intima of the arteries in arteriosclerosis and endarteritis, in chronic productive inflammations of the serous membranes, in cirrhosis of the liver, in chronic interstitial nephritis, and in certain scars and tumors of the skin.

The writer endeavored to determine whether newly formed elastic fibres constituted a part of the stroma of carcinoma. Thirty-seven carcinomata growing in various organs were studied, with the following conclusions:

1. When the stroma of carcinoma is itself of new formation it is usually free from elastic fibres.
2. Newly formed elastic fibres may occur in the stroma, though rarely, and they are likely to be fine in quality and small in number.
3. The tumors, in which newly formed elastic fibres occurred, either contained a large amount of connective-tissue stroma, or the newly formed elastic fibres were in connection with preexisting elastic elements of the original parts.

#### XI.

Cirrhosis of the Liver of the Guinea-Pig Produced by a Bacterium (*Bacillus Coli Communis*) and Its Products. By GEORGE H. WEAVER, M. D., Assistant Professor of Pathology, Rush Medical College, Chicago. With 2 figures in the text. (Pages 297 to 305.)

The injurious agents which act acutely upon the liver affect the cells of the liver and bile-ducts, the character and strength of the agent determining the degree of injury produced. Only two substances which act in a chronic manner stimulate the growth of connective tissue. An important factor in determining the effects of injurious agencies upon the liver is to be found in the peculiarities of the tissues of the individual. The organism studied belongs to the group of colon bacilli. The live cultures and those which had been devitalized by heat when injected into guinea-pigs produced exten-

sive cirrheses in the liver of the animals. The early changes were in the form of necrosis, the connective-tissue proliferation following a little later.

#### XII.

On the Muscular Architecture and Growth of the Ventricles of the Heart. By JOHN BRUCE MACCALLUM, Baltimore. With 24 figures in the text. (Pages 307 to 335.)

By the study of embryonic hearts of various ages, macerated in nitric acid, the organ was found to consist of several layers of muscle, the course of which is described in some detail. Nearly all the fibres begin in the auriculoventricular ring of one ventricle, and end in the papillary muscles of the other. Those fibres which begin near the outside of one ventricle end near the inside of the other ventricle. The thin superficial layers being removed, the left ventricle can be unrolled so that its cavity and papillary muscles are exposed. This shows it to be a flat band of muscle continuous with the muscle fibres that cross over in the septum from the right ventricle. Grouping these layers together it is clear that the heart in the embryo is a scroll-shaped band of muscle with tendons at each end. As it grows older the layer of muscle passing over in the septum remains comparatively thin, while the ventricular walls increase greatly in thickness. The growth takes place mainly near the inside of the ventricular walls, as shown by the presence of karyokinetic figures near the endocardium and by the fact that the muscle-cells in this situation are younger in an actively growing heart than those near the surface of the organ. These growing points must therefore be at the two ends of the unrolled heart. The heart, then, resolves itself into a flat band of muscle with a growing point at either end.

#### XIII.

Some Observations upon the Anatomy of the Gall-Bladder and Ducts. By GEORGE E. BREWER, M. D., Assistant Demonstrator of Anatomy, College of Physicians and Surgeons, New York. With 5 plates and 50 figures in the text. (Pages 337 to 354.)

In this paper are given the results of 160 dissections of the gall-bladder region in the adult human subject, which were carried out during the years 1898-99 at the anatomical laboratory of the College of Physicians and Surgeons (Columbia University), New York. These observations were originally undertaken by the writer with a view to familiarizing himself with the normal relations of the structures in this vicinity, and of perfecting his technique in handling and suturing them. Noting numerous variations from the normal, and certain rather striking abnormalities which were of decided surgical interest, the writer extended his studies far beyond the limit originally intended. In addition, numerous observations were made on the size of the gall-bladder, the length and calibre of the ducts, the surgical relations of the duodenal orifice of the common bile-duct, and an effort was made to establish certain landmarks by which it may be rapidly located through an incision in the duodenum. Observations were also made with a view to establish landmarks by which the operator could rapidly locate and accurately mark out

the position of the principal nerve-trunks likely to be injured by an incision through the abdominal wall in this region. In this paper are also included observations upon the distribution of the hepatic artery, which are illustrated by fifty figures of actual dissections, showing numerous variations and many anomalies of interest to surgeons who are accustomed to operate in this region.

## XIV.

A Case of Plexiform Neuroma of the Eyelid (Rankenneuron).

By HARRY FRIEDENWALD, M. D., Associate Professor of Ophthalmology, College of Physicians and Surgeons, Baltimore. With 2 plates. (Pages 355 to 357.)

The patient, female, was 16 years of age. The abnormality was first noticed when she was a few months old. Two operations had been performed when she was a child. The right upper lid was greatly hypertrophied, especially in its temporal part; the lower lid but slightly affected. There was almost complete ptosis and the thickness of the lid was greatly increased. Firm, round and corded masses could be felt under the skin and could be followed back into the orbit.

At the operation fine white threads characteristic of the growth were found and removed. The growth was easily freed from the orbit with a blunt instrument and was found to extend much deeper into the orbit than was expected. The tumor was found to consist in great part of masses of whitish fibres varying greatly in thickness and weighing seven grammes. Sections showed the characteristic appearance of neuromata. Everywhere there were found smaller and larger nerve bundles imbedded in a framework of connective tissue. Some—for the most part smaller—bundles showed nothing abnormal. Others again presented varying degrees of hyperplasia of the endo- and perineurium with the nerve elements placed more or less centrally, or with a few scattered axis cylinders in the periphery. There were other bundles again in which the hyperplasia was still greater, and in which it was difficult to recognize any nerve elements whatever.

## XV.

A Case of Multiple Myeloma. By JAMES H. WRIGHT, A. M., M. D., Pathologist to the Massachusetts General Hospital, Boston, Mass. With 3 plates. (Pages 359 to 366.)

## XVI.

The Development of the Musculature of the Body-Wall in the Pig, including its Histogenesis and Its Relations to the Myotomes and to the Skeletal and Nervous Apparatus. By CHARLES RUSSELL BARDEEN, M. D., Associate in Anatomy, The Johns Hopkins University. With 10 plates. (Pages 367 to 399.)

The investigation considers the development of the intrinsic thoraco-abdominal musculature from the myotomes in the pig's embryo. The histological changes taking place in the musculature are described, as well as the early relations of the musculature to the nervous and skeletal apparatus.

Three periods are recognized in the development of the musculature:

1. The period during which the myotomes expand dorsally and send ventral processes into the *membrana reuniens*. The

cells, both of the mesial and the lateral plates of the myotomes are shown to be converted into muscle-fibres.

2. The period during which the tissue of the myotome becomes utilized in the formation of the muscles characteristic of the adult. Segmentation is shown to persist only where the muscle-tissue remains throughout united to the vertebrae or to the ribs. The peripheral nerves are shown to develop independently of the myotomes, and to become associated directly with the musculature only after the muscles have become differentiated.

3. The period during which the muscles expand, become perfected in internal structure and are shifted into the relative positions characteristic of the adult.

Cell-multiplication takes place during the first two periods and during the early part of the third. Cell-division takes place by mitosis in round undifferentiated "myoblasts." From these the muscle-cells are developed by elongation of the cell-body, nuclear multiplication by direct division, and fibrillar differentiation of the protoplasm. The differentiated muscle-cells do not divide to form new cells. During the third period, however, many of the muscle-cells undergo retrograde metamorphosis.

## XVII.

A Rare Variety of Adenocarcinoma of the Uterus. By THOMAS S. CULLEN, M. B., Associate in Gynecology, The Johns Hopkins University. With 3 figures in the text. (Pages 401 to 407.)

In the uterus we have three distinct varieties of epithelium: the squamous epithelium of the vaginal portion, the very high cylindrical pale-staining epithelium lining the cervical canal and the racemous glands, and the cylindrical ciliated epithelium of the body. From these three distinct kinds of epithelium three definite varieties of carcinoma develop. And, in fact, nearly all carcinomata of the uterus may be classified under one of the three varieties:

- (1) Squamous cell carcinoma of the cervix.
- (2) Adenocarcinoma of the cervix.
- (3) Adenocarcinoma of the body of the uterus.

The accompanying case differs materially from any that we have yet seen. Clinically, it is interesting to note the advanced age of the patient, who was 76 years old. There had been no hemorrhages at any time and notwithstanding the extent of the growth the symptoms were of only one year's duration. On examining Figure 1, one is immediately impressed with the uniform involvement of the entire uterine cavity, the body being equally as much implicated as the cervix. The surface also presents dome-like elevations instead of the papillary or tree-like growths so common both in adenocarcinoma of the cervix and body. Another marked feature is, that notwithstanding the advanced age of the patient, the uterus is the size of a three-months pregnancy.

On histological examination the growth is found to be glandular in type. These glands are large and lined by one layer of high cylindrical epithelium, the nuclei of which rest directly on the basement membrane and the gland-cavities contain a homogeneous material that takes the hematoxylin



stain. In other words, both the glands and their contents resemble those found in the cervix.

#### XVIII.

A Bacteriological and Microscopical Study of over Three Hundred Vesicular and Pustular Lesions of the Skin with a Research upon the Etiology of Acne Vulgaris. By T. CASPER GILCHRIST, M.D., Clinical Professor of Dermatology, The Johns Hopkins University. With 1 plate. (Pages 409 to 430.)

Stained smears were examined from every lesion. A summary of the results is as follows:

*Lepetigo Contagiosa*.—From every one of the 17 cases examined the streptococcus pyogenes was obtained, and in ten cases it was in pure culture. In 7 cases the staphylococcus pyogenes aureus also grew. The disease was reproduced in three cases by inoculating with a pure culture of the streptococcus obtained.

*Ecthyma*.—Two cases yielded pure cultures of streptococcus pyogenes.

*Staphylococchia or Folliculitis Staphylogenes*.—Sixteen cases examined: two cases yielded pure cultures of streptococcus pyogenes; in five cases the *S. pyogenes albus* was also present; in seven patients the *S. pyogenes aureus* was present in pure culture.

*Trichophytosis*.—In a case of tinea barbæ one culture yielded a pure growth of tinea megalosporon ectothrix, whereas in the second culture the *S. pyogenes aureus* was also present. By inoculation experiments on two men it was proved that the fungus was pyogenic and that therefore the pustular lesions of tinea barbæ may be produced by the fungus alone without the presence of the ordinary pus organisms. The same results were proven in a case of tinea circinata where pustules were present and a pure culture of the tinea megalosporon endothrix was obtained. It was also shown that the same fungus was the cause of pustular lesions on a boy's scalp.

*Furunculosis*.—From 20 cases pure cultures of the *S. pyogenes* were obtained in every case.

*Scabies*.—Nine cases; the staphylococcus pyogenes grew in pure culture in 4 cases; in 2 cases the *S. pyogenes aureus* was also present; the albus being present alone in the ninth case.

From beneath scales of pediculosis capitis and corporis, cultures of streptococcus pyogenes and *S. pyogenes aureus* and albus usually combined.

The *S. pyogenes aureus* grew in pure culture from 3 cases of sycosis vulgaris.

The pustular lesions of syphilis were shown, with two exceptions, to be due to mixed infections of the streptococcus and *S. pyogenes aureus* and albus.

Cultures were negative in 10 cases of herpes zoster (vesicles), 2 cases of sebaceous cyst, 15 cases of dermatitis venenata (vesicles), 4 cases of pernio (vesicles), 3 cases of erythema multiforme (vesicles), and one case of pemphigus pruriginosus.

*Eczema*.—Nineteen cases; in cultures from 6 vesicles, 5 were sterile, while one showed the *S. pyogenes albus*. In 13 cases of eczema madidans, 5 gave the staphylococcus pyogenes aureus alone, 4 yielded the albus, and 2 were sterile after

wiping the surface of the lesions. Out of 10 cases of pustular eczema, 2 gave the *S. pyogenes aureus*, 4 showed the albus, 2 cases yielded both aureus and albus, and one was sterile.

*Acne Vulgaris*.—This yielded the best results. 96 lesions from 54 patients were examined. 54 cultures were sterile; 31 showed from one to many colonies of staphylococcus pyogenes albus; 11 cultures gave pure growths of a bacillus in glycerin-agar. All the smears from the pus showed bacilli. This bacillus grew slowly en masse in glycerin agar. The colony at first was creamy white, later it became pinkish, then almost black in one very old culture. It grew on glucose-agar without forming gas; grew in bouillon; invisibly on potato; grew fairly well on blood-serum, but not in Dunham's or milk. It did not decolorize by Gram's stain, was motile and branched. It killed mice and guinea-pigs. Bacillus acnes was the name suggested for this micro-organism.

#### XIX.

The Frequency and Significance of Infarcts of the Placenta, Based upon the Microscopic Examination of 500 Consecutive Placentæ. By J. WHITRIDGE WILLIAMS, M.D., Professor of Obstetrics, The Johns Hopkins University, and Obstetrician-in-Chief to The Johns Hopkins Hospital. With 3 plates. (Pages 431 to 460.)

#### XX.

A Contribution to the Knowledge of the Bacillus Aërogenes Capsulatus. By W. T. HOWARD, JR., M.D., Professor of Pathology, Western Reserve University, Cleveland, Ohio. With 1 plate. (Pages 461 to 495.)

After a review the author reports thirteen cases of gas-bacillus invasion, which he divides into three groups:

Group I. Bacilli entering the body through the genitourinary tract—two cases. In one there were cerebrospinal meningitis and brain abscesses, both containing gas-cysts and general gaseous emphysema due to *B. aërogenes capsulatus*. In the second case, with abscess of the prostate, chronic cystitis, pyonephritis and gaseous emphysema, the bacillus was concerned in the renal lesions.

Group II. Bacilli entering through the biliary tract—two cases. In one the gas bacilli were limited to the gall-bladder and liver, and in the other—a case of typhoid fever—there was general gaseous emphysema, best marked in the liver and biliary tract.

Group III. Bacilli entering through lesions of the stomach and intestines,—nine cases, comprising the following lesions as the portal of entry: strangulated hernia; necrosis of the stomach with gas blebs (typhoid fever); crushing injuries, involving the gastro-intestinal tract; intestinal ulcers (typhoid, two cases, lymphosarcoma, one case); and post-mortem disintegration of the stomach and ileum (four cases).

In the last four cases, microscopically, there were no gas-cysts found in the gastro-intestinal tract, which on microscopical examination showed both cysts and bacilli.

The author next discusses the various modes of invasion, the destruction of the bacilli in the body and their effect upon the lesions.

## XXI.

The Intravascular Growth of Certain Endotheliomata. By W. G. MACCALLUM, Associate in Pathology, The Johns Hopkins University. With 1 plate and 4 figures in the text. (Pages 497 to 510.)

The writer, after reviewing the records of several similar cases in the literature, gives the clinical history and autopsy protocol of a case which occurred at The Johns Hopkins Hospital. The tumor of the testicle was incompletely extirpated and at the autopsy, several months later, the extension along the spermatic vein could be traced into the vena cava, filling it with translucent papillary masses which extended into the heart. Large metastatic nodules were found on lungs, liver and elsewhere. The tumor was shown to spring from spaces with endothelial lining thought to be the lymphatic spaces. The proliferation of these cells produced not only cyst-like cavities but complicated cell masses. Especial interest attached to the relation of the tumor to the blood-vessels, as the intravascular papillary masses generally hung free in the blood, and were overgrown by the endothelium of the vessel.

## XXII.

The Cultivation of Amœbæ. By CASPER O. MILLER, M. D., New Market, Va. (Pages 511 to 523.)

Cultures were made in sterilized Erlenmeyer flasks with water containing a small percentage of organic matter. In all of the cultures living bacteria were present.

The fact that encysted amœbæ withstand drying was taken advantage of to eliminate from the cultures those protozoic forms which do not withstand drying. Algae were eliminated by excluding the light from the cultures.

The amœbæ were gathered from various sources; of these some have been cultivated since 1889. Some cultures containing encysted amœbæ have been dried for six years without killing the amœbæ. Some of the amœbæ cultivated did not encyst. Of those encysting, two varieties have been studied: one forming spherical cysts—A. Sphærocystis; and the other forming irregularly shaped cysts—A. Irregularia.

In the culture of A. Sphærocystis, oval cysts resembling coccidia in many respects are found at times, and there are also occasionally present sharply defined, consecutive bodies.

Although it is not proven, at the same time it is questioned whether Amœbæ Sphærocystides, coccidia and the crescents, are not phases in the development of the same organisms. Those who have cultivated amœbæ on solid media only describe them as multiplying by division, but in the fluid cultures there are appearances which seem to indicate that amœbæ also multiply by segmentation.

## XXIII.

The Bacillus Pseudo-Tuberculosis Murium: Its Streptothrix Forms and Pathogenic Action. By DOROTHY M. REED, Baltimore. With 1 plate. (Pages 525 to 541.)

A study of the B. pseudo-tuberculosis murium first isolated by Dr. Welch in 1894: described by Kutscher in Germany in 1896; recovered in Baltimore in 1897, from a spontaneous case of pseudo-tuberculosis in a mouse.

This paper deals with the cultural properties of the organism, previously undetermined, with the study of the conditions under which the organism varies from its usual form of a simple rod in giving off side branches, and with the nature of the pathological lesions on the animal body. It is shown that the bacilli branch in the body and in artificial media; and that in the body aggregations of bacilli appear, which resemble the "Drüsen" of actinomyces. In the tissue lesions the nodules differ from true tubercles, in being composed of bacteria and not of proliferated or emigrated body-cells.

## XXIV.

Experimental and Surgical Notes upon the Bacteriology of the Upper Portion of the Alimentary Canal, with Observations on the Establishment There of an Amicrobic State as a Preliminary to Operative Procedures on the Stomach and Small Intestine. By HARVEY CUSHING, M. D., Associate in Surgery, The Johns Hopkins University, and LOUIS E. LIVINGOOD, M. D., Late Associate in Pathology, The Johns Hopkins University. With 8 figures in the text and 1 diagram. (Pages 543 to 591.)

From numerous clinical observations upon the character of the peritonitides consequent to perforating wounds of the alimentary canal it seemed probable that the severity of the infection bore a distinct relation to the situation of the perforation and that the favorability of the prognosis was proportionate to the nearness of the lesion to the stomach.

This suggestion, originating from clinical data alone, was the occasion of a series of experimental observations upon animals and human beings relative to the bacteriological features of the alimentary canal, especially of its upper portion. A great scarcity of micro-organisms was found to be the invariable rule in the neighborhood of the duodenum of the 35 dogs and rabbits which were examined under varying dietary conditions. With certain precautionary measures, such as sterilization of the ingesta and a fast of a few hours, a condition of amicrobism could almost without exception be brought about in the stomach and upper portion of the intestine of a healthy animal.

Adaptation to surgical procedures of the principles established by this experimental work has shown the feasibility, under a certain dietary régime, of rendering the upper portion of the alimentary canal practically free from micro-organisms in anticipation of operative work on the stomach and upper intestine, so that exposure of the lumen of the canal is unattended by risks of ensuing peritonitis.

## XXV.

The Origin, Development and Degeneration of the Blood-vessels of the Human Ovary. By JOHN G. CLARK, M. D., Professor of Gynecology, University of Pennsylvania. With 5 plates and 11 figures in the text. (Pages 593 to 676.)

The author contributes a special research upon the ovarian circulation, in which the normal distribution of the arteries and veins of the ovary and their relationship to each other have been studied. At first sight the solution of this question did not appear to present greater difficulties than those en-

countered in the ordinary course of any research. A review of the sections of a few injected adult ovaries, however, at once demonstrated the futility of attempting to draw any conclusions from this source; for the close crowding together of the parallel vessels of the medullary portion, and the markedly irregular course of those in the cortex, or follicle bearing zone, rendered impossible any accurate observations concerning the relative number and distribution of the veins and arteries and the exact course followed by each system.

With a view, therefore, of securing ovaries possessing a simpler scheme, a study was made of the lower animals, such as the dog, rabbit, guinea-pig, sheep and pig, but with unsatisfactory results, and only after the injection of the generative organs of a monkey was a suggestive clue secured. Beyond this point, however, it was difficult to proceed; and only after the injection of a very large series of ovaries from individuals, ranging in age from a six-months fetus to a woman many years beyond the menopause, were final conclusions reached.

In the search for this normal scheme through an extensive number of serial sections, various questions directly dependent upon the circulation presented themselves for solution, which widened the scope of this work until it developed into a composite anatomical and physiological research.

Thus, the various vital phenomena have been considered which transpire within the follicle from its embryological origin and progressive growth to the time of its disappearance, either through an obliterative process or through its rupture, organization as a corpus luteum, and final retrogression as a corpus fibrosum. In this connection the author has advanced theories concerning the development of the ovary; the differential signs of sex; the descent of the ovary; the cause of ovulation; the synchronism of ovulation and menstruation; the mechanism of the rupture of the mature follicle, and the final cessation of ovulation; which have been based upon observations made in the study of a very large number of sections.

Soon after beginning this work he was struck not only with the difficulty of arriving at a definite knowledge of the scheme, but also of determining the age at which this scheme may be taken as a standard for comparison.

This is certainly not possible after active ovulation is established; for the constant changes in the vascular system, induced through the maturation, rupture and organization of the follicle, introduce an element of variability into the circulation of this organ which occurs in no other.

Failing to reach any satisfactory starting point in the adult, the author next studied the ovary of a girl approaching puberty, but with little more success, for it was found that almost as constant variations occur in the follicular circulation before as after the inauguration of ovulation. In the hope of finally reaching a period in the life of the female individual at which a definite standard for comparison might be found, numerous specimens from children of various ages were injected and closely studied. Finally, the ovary of a six-months fetus was obtained, which furnished a definite clue to the arrangement of the vessels; but as the follicular apparatus was still in process of development, a new-born child in which the tunica albuginea was well formed was selected as the standard. Even here the solution of the question was not easy, for in

order to trace the ramifications of the vessels from the point of their entrance into the ovary to their ultimate termini the study of the serial sections of many ovaries was necessary.

#### XXVI.

**The Gonococcus.** A Report of Successful Cultivations from Cases of Arthritis, Subcutaneous Abscess, Acute and Chronic Cystitis, Pyonephrosis and Peritonitis. By HUGH H. YOUNG, M. D., Instructor in Genito-Urinary Diseases, The Johns Hopkins University. (Pages 677 to 707.)

This report represents a study of unusual infections of the gonococcus occurring at The Johns Hopkins Hospital during the past four years.

Gonorrheal arthritis is first considered, and a complete tabulation is given of ten cases in which pure cultures of the gonococcus have been obtained from diseased joints.

Five cases of subcutaneous abscesses due to the gonococcus are presented, together with a careful review of the literature showing the great rarity of such cases.

A case of general suppurative peritonitis, in which the gonococcus alone was grown from the peritoneal exudate, being the only case on record, is detailed.

In the discussion of gonococcus cystitis, a review of the literature shows that only two cases of acute cystitis in which the organism of Neisser was obtained in pure culture, and one case where by aspiration of the bladder pure cultures of the gonococcus were obtained from the urine, are recorded. In others it was found on coverslip preparations.

A case of chronic alkaline cystitis of four years' duration, due to the gonococcus alone, is presented as the first case in the literature, and the occurrence of a double pyonephrosis in the same case, due to the same organism, and likewise the first recorded instance, is mentioned.

The literature of kidney affections following gonorrhœa is reviewed at length, and a historical résumé of the successive demonstrations of the widespread infective powers of the gonococcus is appended.

#### XXVII.

**The Histogenesis of the Cellular Elements of the Cerebral Cortex.** By STEWART PATON, M. D., Assistant in Clinical Neurology, The Johns Hopkins University. With 7 figures in the text. (Pages 709 to 741.)

#### XXVIII.

**Experimental Pancreatitis.** By SIMON FLENNER, M. D., Professor of Pathology, University of Pennsylvania, Philadelphia. (Pages 743 to 771.)

The study upon which this paper is based consists of a series of experiments carried out upon dogs in which injections of acids, alkalies and other chemicals, as well as bacterial cultures, have been made into the duct of Wirsung and the interstitial tissue of the pancreas. By the several procedures employed, hemorrhagic, suppurative, necrotizing and chronic indurative pancreatitis have been produced. There has been frequently associated with these conditions fat-necrosis both in the peritoneal cavity and in the distant fat. The several forms of pancreatitis produced have been considered in their relation



to pancreatitis in human beings. The histology of the lesions is also described and a comparison is drawn between the changes found in the experimental cases and those described in similar lesions in human beings. Attention has been paid to the cause of fat-necroses with the determination that in all of them the fat-splitting ferment in quantities demonstrable by chemical test existed.

## XXIX.

**Chronic Hypertrophic Gastritis of Syphilitic Origin, Associated with Hyperplastic Stenosis of the Pylorus.** By JOHN C. HEMMETER, M. D., Clinical Professor of Medicine, University of Maryland, and WM. ROYAL STOKES, M. D., City Bacteriologist, Baltimore. With 4 figures in the text. (Pages 773 to 794.)

The most important pathological changes noted in cases of gastric syphilis are ulceration, necrosis, and atrophy of the mucous membrane of the stomach, with a marked chronic interstitial increase of the connective tissue of the submucous coat. Large fibrous bands also extend into the muscular coat of the organ.

The case which the authors of this article report, gave a typical history of syphilis. The patient showed an absence of free and combined HCl, and pyloric stenosis was suspected. A surgical operation was performed for relief of the symptoms, and the patient died one month later.

An autopsy showed general infection with the bacillus pyocyaneus and staphylococcus aureus, and the stomach was found shrunken to about one-third of its natural size. There was marked pyloric obstruction, without tumor or ulcer. The submucous coat was thickened and the mucous membrane coarsely granular in appearance.

A microscopic examination showed atrophy of the glands of the mucous membrane, with the formation of villous-like projections, or diffuse formation of young fibrous tissue. The submucosa shows a marked thickening due to the presence of fibrous tissue with many areas of lymphoid cells, especially about the smaller veins.

This fibrous tissue extended to the muscular coat, and in places the peritoneum was thickened. The blood-vessels showed multiplication of the intimal cells but no other marked changes. These changes were more marked at the pylorus, but were apparent in sections taken from various portions of the organ.

The history of the case and the changes described justify the belief that the entire pathological process in the stomach was syphilitic in character.

## XXX.

**A Case of Adenocarcinoma which Originated in the Submucous Glands of a Trachea-Like Formation, Found in a Sacral Teratoma.** By WILLIAM H. HUDSON, M. D., La Fayette, Ala. With 2 plates. (Pages 795 to 804.)

A case of adenocarcinoma which developed from the submucous glands of a trachea-like formation found in a sacral teratoma is reported.

Among the foetal structures found in the teratoma were the trachea, the oesophagus, the posterior spinal ganglia, and other structures resembling normal physiological tissues.

The special interest in this communication centres in the malignant changes which were found to exist in the tumor. Reported cases of malignancy in teratomata are exceedingly rare, by far the largest number of such cases being of the epidermal type. The case here reported, and one other, are all the reported cases of teratomata in which malignancy has originated from glandular structure.

The surgery of teratomata is also considered, and the removal of these tumors is advised in every case, where such operations can be performed with safety to the patient.

## XXXI.

**On Hydromyelia in Its Relation to Spina Bifida and Cranioschisis.** By E. BATES BLOCK, M. D. With 3 plates. (Pages 805 to 858.)

## XXXII.

**Experimental, Disseminated Fat-Necrosis.** By EUGENE L. OPIE, M. D., Assistant in Pathology, The Johns Hopkins University, Baltimore. With 1 plate. (Pages 859 to 876.)

The relation of fat-necrosis to lesions of the pancreas was studied experimentally in cats. If the outflow of pancreatic secretion is completely obstructed by ligating both pancreatic ducts, foci of fat-necrosis are produced and may be widely disseminated. In two instances, in which the animals lived twenty-five and twenty days after the operation, almost the entire abdominal fat was opaque-white and necrotic, and foci of necrosis were found in the subcutaneous and pericardial fat. The presence of a fat-splitting ferment was demonstrated in the necrotic fat. In other instances, in which the animals lived a shorter time, less extensive necrosis resulted. Assuming that after duct-ligation a gradual diffusion of pancreatic juice or of the fat-splitting ferment occurs, the attempt was made to hasten the diffusion by stimulating, after ligation of the ducts, the secreting activity of the gland with pilocarpin. After the death of the animal extensive necrosis of the abdominal fat with foci in the pericardium was found. To test the ability of the fully formed pancreatic juice to cause necrosis of fat the duodenal end of the organ was transplanted in such a way that the secretion was poured into the subcutaneous tissue of the abdominal wall; typical fat necrosis resulted.

The condition essential to the production of focal fat-necrosis is the penetration of the fat-splitting ferment of the pancreas into living fat, and the lesions of the pancreas associated with fat-necrosis are such as permit this diffusion into the surrounding tissue. The widespread necrosis occasionally observed in man and in animals may be reproduced experimentally by conditions which favor diffusion of the ferment.

## XXXIII.

**Multiple Hyperplastic Gastric Nodules Associated with Nodular Gastric Tuberculosis.** By CLARIBEL CONE, M. D., Professor of Pathology, Woman's Medical College, Baltimore. (Pages 877 to 890.)

The report is of a case of tuberculosis of the stomach occurring in the course of a general military tuberculosis, which came to autopsy in the pathological laboratory of The Johns

Hopkins Hospital in October, 1898. Besides the tuberculous infection of the stomach, gastric lesions of unusual character were also found.

From the surface of the stomach projected numerous small granules and occasional larger rounded nodules, varying in size from that of a pin-head to that of a pea.

Upon microscopic examination these nodules presented several histological types. There were (1) nodules due to connective-tissue overgrowth or to irregular fibrous contraction; (2) atypical glandular nodules; (3) nodules specifically tuberculous.

The connective-tissue nodules are doubtless a feature of chronic gastritis which was present. The atypical glandular nodules possess in part the features of a neoplasm; in part, the features of a simple hyperplastic growth.

Glandular hyperplasia seems more probable because there are present in the same mucous membrane simple proliferating gastric tubules, irregular groups of two, three or more tubules, larger irregular collections, and the circumscribed nodules themselves, all having a similar general structure, and all, no doubt, an expression of the same pathologic process.

The tuberculous nature of some of the nodules has been shown beyond question by both the histologic and the bacteriologic examination.

Between the tubercles and the hyperplastic glandular nodules no direct relation can be traced.

#### XXXIV.

On Serum Substitutes with Special Reference to Asiatic Cholera. By ARTHUR BLACHSTEIN, B. A., M. D. (Pages 891 to 901.)

#### XXXV.

Endocarditis Due to a Minute Organism, Probably the Bacillus Influenzae. By MABEL F. AUSTIN, Baltimore. (Pages 903 to 911.)

In three cases of endocarditis which have come to autopsy, a minute bacillus was found which differs from any of the bacteria previously described as the cause of the disease.

The bacillus is identical in its peculiar morphological characteristics with the *B. influenzae* of Pfeiffer. Cultures were not obtained. The organism is very minute. It stains with the basic anilin dyes, but rarely uniformly; usually the poles of the bacillus take the stain more intensely, giving the appearance of a diplococcus. When treated by Gram's method the bacillus is readily decolorized. Great numbers of the organisms were found in the coverslip preparations made from the diseased valves, and in sections of the recent vegetations, and in one case clumps of bacilli were found also in the lung alveoli. No other micro-organisms were present.

While the failure to obtain cultures forbids definite conclusions as to the nature of the organism, it seems very probable from the evidence obtained that the bacillus is the *Bacillus influenzae*. This is of especial interest in connection with the many clinical reports of endocarditis occurring as a complication of influenza. The clinical histories of the three cases are given with the histological and bacteriological studies of the tissues obtained at autopsy. A brief review of the literature bearing on the subject is presented.

#### XXXVI.

On a Case of Chronic Nephritis Terminating with Symptoms of Landry's Paralysis. By LEWELLYS F. BARKER, Associate Professor of Pathology, The Johns Hopkins University. (Pages 913 to 923.)

The paper records a case of chronic diffuse nephritis which for two weeks before death presented the symptoms of acute ascending paralysis. At autopsy there were small red granular kidneys; an acute terminal hæmorrhagic colitis due to the streptococcus pyogenes was present. The microscopic examination of the spinal cord and brain revealed lesions in the nerve-cells and in the blood-vessels. The lumbar cord was most affected, but there were alterations as high as the cerebral cortex. Not only were the motor-cells involved but alterations were also met with in the nerve-cells of the nuclei of the dorsal funiculi in the medulla oblongata.

#### XXXVII.

Model of the Medulla, Pons and Midbrain of a New-Born Babe. By FLORENCE R. SABIN, Baltimore. With 8 plates and 52 figures in the text. (Pages 925 to 1045.)

The article contains a description of a model of the medulla, pons and midbrain of a new-born babe made after the wax-plate method of Born. It was prepared from a series of horizontal sections stained by the method of Weigert-Pal, and it reproduces in three dimensions, the various structures of the region so magnified that they can be seen and easily handled. The model, moreover, can be taken apart completely.

The model illustrates the form and position of each tract, the course of development being thereby suggested. The fact that the medial and lateral lemnisci which form the main sensory tracts are closely related in form to the other structures, while the pyramidal tract has but little or no influence in moulding the other parts, is emphasized.

The cerebral nerves and their nuclei are described and grouped according to their position and form, and these groups also illustrate the course of development. The most curious and interesting form, perhaps, met with in the model is that of the inferior olivary nucleus, its gyri and sulci being clearly indicated. The relation of the medulla oblongata to the spinal cord is also illustrated. The mode in which the white and gray matter continue into the medulla, the changes these undergo and the intrinsic structures of the medulla, pons and midbrain are in turn considered.

#### XXXVIII.

A Contribution to the Surgery of Foreign Bodies. By WILLIAM S. HALSTED, Professor of Surgery, The Johns Hopkins University. With 3 plates and 1 figure in the text. (Pages 1047 to 1059.)

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## SUMMARIES OR TITLES OF PAPERS BY MEMBERS OF THE HOSPITAL AND MEDICAL SCHOOL STAFF APPEARING ELSEWHERE THAN IN THE BULLETIN.

THOMAS McCRAE, M. B. Spleno-Myelogenous Leukemia: with Disappearance of the Spleen Tumor and of the Myelocytes from the Blood.—*The British Medical Journal*, March 31, 1900.

The patient, whose case is reported, came under observation twice in one year, with typical signs of spleno-myelogenous leukemia. On each occasion the spleen tumor gradually disappeared, the leucocytes returned to normal and the myelocytes disappeared. He ultimately died, apparently of cerebral hæmorrhage. No similar case was found in the literature, although instances of disappearance of one of these conditions named are not uncommon.

HUGH H. YOUNG, M. D. The Present Status of the Appendicitis Question, as Shown by the Recent Literature and Society Transactions of France, Germany, England, and the United States.—*Maryland Medical Journal*, April, 1900.

THOMAS R. BROWN, M. D. Progress in Pediatrics.—*Maryland Medical Journal*, April, 1900.

ANDREW H. WHITRIDGE, M. D. Can Beginning Pulmonary Tuberculosis be Diagnosed Through a Shirt?—*The Medical Examiner and General Practitioner*, April, 1900.

HUNTER ROBB, M. D. A Clinical and Pathological Report of Two Cases of Genital Tuberculosis.—*Cleveland Medical Gazette*, March, 1900.

THOMAS R. BROWN, M. D. Cystitis due to the Typhoid Bacillus Introduced by Catheter in a Patient not Having Typhoid Fever.—*Medical Record*, March 10, 1900.

JOHN G. CLARK. Two Cases of Extrauterine Pregnancy.—*American Journal of Obstetrics*, April, 1900.

HENRY C. COE, M. D. Pain as a Pathognomonic Symptom of Ectopic Pregnancy.—*Medical News*, April 21, 1900.

WILLIAM OSLER, M. D., and THOMAS McCRAE, M. B. (Tor.). Cancer of the Stomach in the Young.—*New York Medical Journal*, April 21, 1900.

SIMON FLEXNER, M. D., and LEWELLYS F. BARKER, M. D. Prevalent Diseases in the Philippines.—*Science*, April 6, 1900.

T. CASPAR GILCHRIST. Two Unusual Cases of Annular Syphilides in Negroes.—*Maryland Medical Journal*, April, 1900.

THOMAS R. BROWN, M. D. Cystitis Caused by the Bacillus Pyocyaneus. Progress in Medicine.—*Maryland Medical Journal*, May, 1900.

HARRY T. MARSHALL, M. D. A Study of Christian Science.—*Md. Med. Jour.*, May, 1900.

H. O. REIK, M. D. Some Interesting Cases of Mastoiditis.—*Md. Med. Jour.*, May, 1900.

ROBERT REULING, M. D. Pathology and Neurology.—*Md. Med. Jour.*, May, 1900.

HUGH H. YOUNG, M. D. Progress in Surgery.—*Md. Med. Jour.*, May, 1900.

### NOTES ON NEW BOOKS.

Diseases of the Stomach. By JOHN C. HEMMETER, M. D., of Baltimore. (P. Blakiston's Son & Co. Philadelphia, 1900.)

This is the second edition of this work which originally appeared in 1897. To the first edition a number of illustrations and nearly one hundred pages have been added. The general plan of the work has not been changed. Among the new material the articles on Hypertrophic Stenosis of the Pylorus, Obstruction of the Orifices, and Hemorrhage from the Stomach are specially noticed. Recent work and literature have been carefully used. The bibliography given is a very valuable feature of the book, but many readers would prefer to have fewer references inserted in the text. In using the book we have often found the lack of orderly arrangement rather a drawback. The exact whereabouts of all the points on a given subject are often found with difficulty. The work has been found very useful and we congratulate Dr. Hemmeter on his second edition.

The Anatomy of the Brain. By RICHARD H. WHITEHEAD, M. D. (The F. A. Davis Company, 1900.)

This is a book of 96 pages which aims at giving a short and concise account of the anatomy of the brain without too many minor details. It is divided into four chapters dealing with the divisions, the surface anatomy, the internal anatomy and the conducting paths of the encephalon. The text is clear and the giving of the terms adopted by the German Anatomical Society in addition to those commonly used in this country is a helpful feature. The illustrations are good and are not too complicated. Altogether the work should be of great use especially to students, as it is probably the best short description of the brain that we have in English.

### BOOKS RECEIVED.

Transactions of the College of Physicians of Philadelphia. Third series. Volume the Twenty-first. 1899. 8vo. XLVIII + 197 pages. Printed for the College. Philadelphia.

Proceedings of the Philadelphia County Medical Society. Vol. XX. Session of 1899. Joseph M. Spellissy, M. D., Editor. 1899. 8vo. XVIII + 368 pages. Printed for the Society, Philadelphia.

The British Guiana Medical Annual. Edited by J. F. S. Fowler, M. B. Eleventh year of issue. 1899. 8vo. 23 + XXXVII pages. Printed by Baldwin and Co., Georgetown, Demerara.

Injuries to the Eye in their Medico-legal Aspect. By S. Baudry, M. D. Translated from the Original by Alfred James Ostheimer, Jr., M. D. Revised and Edited by Charles A. Oliver, A. M., M. D. With an Adaptation of the Medico-legal Chapter to the Courts of the United States of America, by Charles Sinkler, Esq. 1900. 12mo. X + 161 pages. The F. A. Davis Co., New York, Chicago.

The Medical Annual and Practitioner's Index. Eighteenth Year. 1900. 12mo. LXXX + 871 pages. John Wright & Co., Bristol.

The Pathology and Surgical Treatment of Tumors. By N. Senn, M. D., LL. D. Second edition, revised. Illustrated by 478 engravings, and 12 full-page plates in colors. 1900. 8vo. 718 pages. W. B. Saunders, Philadelphia.

Essentials of Diagnosis. Arranged in the form of Questions and Answers. Prepared especially for Students of Medicine. (Saunders' Question-Compends, No. 17). By Solomon Solis-Cohen, M. D., and Augustus A. Eshner, M. D. Second Edition, revised and enlarged. Illustrated. 1900. 12mo. 417 pages. W. B. Saunders, Philadelphia.



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## Report in Pathology.

An Experimental Study of the Thyroid Gland of Dogs, with especial consideration of Hypertrophy of this Gland. By W. S. HALSTED, M. D.

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VOLUME IV. 504 pages, 33 charts and illustrations.

## Report on Typhoid Fever.

By WILLIAM OSLER, M. D., with additional papers by W. S. THAYER, M. D., and J. HEWETSON, M. D.

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Dementia Paralytica in the Negro Race; Studies in the Histology of the Liver; The Intrinsic Pulmonary Nerves in Mammalia; The Intrinsic Nerve Supply of the Cardiac Ventricles in Certain Vertebrates; The Intrinsic Nerves of the Sub-maxillary Gland of *Meles meles*; The Intrinsic Nerves of the Thyroid Gland of the Dog; The Nerve Elements of the Pituitary Gland. By HENRY J. BARKLEY, M. D.

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# BULLETIN

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## ON THE PRESENT STATUS OF THERAPY AND ITS FUTURE.\*

BY LEWELLYS F. BARKER, M. B., *Tor.*,

*Associate Professor of Pathology, Johns Hopkins University.*

The only means we have of judging what the future has in store is to review the history of the past and to view accurately the present tendency or drift. The history of therapy is the history of medicine, for medicine began with therapy. It is not my purpose in the time allotted to me to undertake a recital of this history; I shall have to be content simply with an enumeration of epochs and perhaps a hint at the periods of progress.

Historians are gradually collecting for us the data concerning the earliest therapeutic efforts. The history of the earliest medicine shows of what a jumble these efforts consisted. With the dawn of intelligence the sympathy which was gradually evolved through the sense of pain led the primitive man to attempt to relieve the pain of his fellows. You recall the lines of a literary medical man:

"The hunt is o'er; the stone-armed spears have won;  
Dead on the hillside lies the mastodon.  
Unmoved the warriors their wounded leave;  
The world is young and has not learned to grieve.

But one, a gentler sharer of the fray,  
Waits in the twilight of the western day,  
Where 'neath his gaze a cave-man, hairy, grim,  
Groans out the anguish of his mangled limb.  
Caught in the net of thought the watcher kneels,  
With tender doubt the tortured member feels,  
And, first of men a healing thought to know,  
He finds his hand can check the life-blood's flow."

Disease is as old as man—it is only the knowledge of disease that is recent. In the fiercer physical struggle for existence which must have characterized the life of our primitive forefathers, external wounds and manglings, as well as physical injuries due to exposure to the weather, to extremes of cold and heat, must have been common. Crude surgical procedures evolved by herdsman or shepherd began to be applied to man. The diseases peculiar to the female sex were first treated by the wise old women who had lived through the mysteries of the life of that sex. Of the nature of disease in general and particular the ghost of a true idea did not exist. Obscure diseases were regarded as instances of demoniacal possession. Prayers, chants and sacrifices to healing gods were universal. Devils were exorcised chiefly through the medium of priests. The priestly art and that

\* Address in medicine delivered before the Ontario Medical Association, Toronto, June 6th, 1900.

of the physician were often combined. In China, in India, in Chaldea, in Egypt, the development of early medicine followed the same fundamental principles, though each country manifested special peculiarities.

The medicine of the Greeks interests us as much as any. Philosophers all, with an intense longing for the good, the true and the beautiful, they have left behind them records which in many respects make modest even the reader of to-day. In Heraclitus, Democritus and Empedocles and, above all, in Hippocrates we meet with much that is practically good in modern medicine and philosophy, especially as concerns the individual life, the ideal development of the personality. Though infants in anatomy and physiology and almost entirely ignorant of the nature of specific diseases, the Greek physicians had accumulated an account of symptoms and conditions and a therapeutic armamentarium that surprises the modern who for the first time reads his Hippocrates. The treatment of fractures and dislocations, the trepanning of the skull, the tapping of the abdomen and chest, the mode of dealing with hernia show us how daring they were in surgical measures. Had they known how to control hæmorrhage, who can tell what operations these cool-headed Greeks might not have devised. They were far less happy in the more difficult field of internal medicine. Most of their ideas about internal diseases were wrong, but some of their descriptions of individual cases are magnificent. Concerning the therapy of internal diseases, Hippocrates had many sound principles, and described some good practice. He recognized the healing power of nature and urged his followers to aid and follow nature—"quo natura vergit, eo tendere oportet." In Hippocrates can be found the tenets of many of the famous schools which have followed him. The principle of "*contraria contrariis*" and that of "*similia similibus*" are both in his pages, but wiser than some who came after him he limited himself to neither. "According to its kind and the circumstances underlying it, a case must sometimes be treated by agents acting unlike the disease, sometimes, on the other hand, the treatment must be undertaken by agents acting similar to the disease. The reason for this lies in the weakness of the human organism." Perhaps the strongest part of the therapy of that day was in the emphasis laid upon diet, gymnastics, bathing and mode of life in general. Who but has read and appreciated the *Charmides* of Plato, that exquisite dialogue in which the principles of Greek temperance are embodied. For a long time after Hippocrates this personal hygiene was accentuated. The visits of young men to the temples of *Æsculapius*, there to be instructed as to how to live, were long continued. Walter Pater's appreciation of a visit of this sort described in *Marius the Epicurean* will be recalled by many of you.

In Galen's time theory and gross empiricism reigned supreme. The idea of the four elements, heat, cold, dryness and moisture influenced the giving of drugs. These elements in a sense corresponded to the four cardinal juices of the human body, blood, mucus, yellow bile and black bile. The

therapeutic ideas of Galen, like his medical ideas in general, dominated medicine for a thousand years.

With the advent of Vesalius and the development of human anatomy one might have hoped for rapid improvement in therapy, but this improvement was not immediately forthcoming. Even Harvey's discovery of the circulation of the blood and Malpighi's studies of physiology and pathology were not immediately fruitful in a therapeutic way. Paracelsus alone stands out as a reformer in internal medicine and therapeutic effort. He bravely opposed the authority of Galen, recognized the fallacy of trusting to knowledge obtained from books and relied rather upon personal observation and experience. Analysis shows, however, that even Paracelsus did but little to advance the actual knowledge of therapy.

About this time there was a wide-spread awakening in all the natural sciences. Descriptive natural science and systemization ruled the thought of the day. During the period which followed a series of medical systems developed, based upon one-sided theories and badly based generalizations; Haller's doctrine of irritability, Brown's doctrine of stimuli, Hahnemann's homeopathy, Gall's phrenology, along with many other schools came at this period to their development.

Real progress in therapy dates from the time when natural science became an exact study. Rigidly accurate observation followed by mature reflection has led to experimentation. Medicine of this sort is only a century old. It was almost synchronous with the widening of chemical discovery and of the working out by physicists of the principles which underlie many natural phenomena which up to the time had been entirely obscure, that microscopic studies began to be prosecuted seriously. Histology developed with Bichat; the cell doctrine with Schleiden and Schwann, pupils of the celebrated Johannes Müller. The French and the Germans became enthusiastic for pathological anatomy. Rokitsky counted his autopsies by thousands. The older physicians like Sydenham and Boerhaave, found worthy successors in Louis, Schönlein, Traube, and Wunderlich.

Virchow's cellular pathology established an entirely new view-point whence disease-processes could be observed. Charles Darwin's work on the "*Origin of Species*," Herbert Spencer's philosophy and Huxley's researches in comparative anatomy stimulated investigators in all sciences to examine into the evolution of phenomena, to consider the order of events in organic processes. Enormous strides continued to be made in physics and chemistry, and the new facts discovered in these branches permitted of the development of physiology by Ernst Brücke, Carl Ludwig, Emil Du Bois Reymond, Helmholtz and Claude Bernard. Caspar Fr. Wolff, Karl von Baer, Balfour, and His unravelled the mysteries of embryonic development. Improvements in the microscope and in microscopic technique led to a deeper penetration into the mysteries of histology and microscopic anatomy, normal and abnormal, than the most enthusiastic could have hoped for a few years earlier. New instruments of all sorts were



devised. Auenbrugger's percussion and Laennec's auscultation revolutionized physical diagnosis. The ophthalmoscope, the laryngoscope and the speculum, had much to do with the establishment of the specialties of ophthalmology, laryngology and gynecology.

In the fight against infectious diseases a great victory had been won in the discovery of vaccination by Edward Jenner. Later on Henle's ingenious speculations concerning the nature of contagious diseases set many great minds in motion. With Pasteur and Koch came illumination. The infectious agent in the majority of infectious diseases is now known, can be cultivated in pure culture and can be utilized in animal experiment.

Physiological and pathological chemistry have been unveiling the mysteries of the fluids and solids of the body; pharmacology and toxicology are investigating the influences of drugs and poisons upon these. The application of Lister's happy idea with regard to wound infection, aided by the American-born boon of anaesthesia and a bloodless technique, totally changed the aspects of surgery. Wound infection, if not entirely an event of the past, has been enormously reduced. The holiest places of the body are to-day invaded by the surgeon's knife; the abdomen, the thorax, the joint cavities and even the brain are frequently and fearlessly explored. The heart, the last organ of man to be made accessible to surgical treatment, can now be sutured with success.

But more time must not be spent in glancing at the past; it is necessary at once to look at the present and to divine, if it be possible, whither we are being led.

As a result of development along so many diverging lines the study of modern medicine is concerned with a field so wide that he who glances over it, cannot fail to be appalled by its magnitude. No single intelligence can in these days be familiar with the details of growth in all its parts; no single individual can hope to work efficiently in more than one or two of its subdivisions. The complexity of the work demands a division of labor, and most is gained from the efforts of men who, familiar with the general trend of progress in the whole field, concentrate their activities upon some one corner of it. Individual workers in the special medical sciences are pushing their investigations at the moment with unwonted zeal. Anatomists are ever devising new technical methods; the cells formerly believed to be very simple "elements" are found to be highly complex organisms; parts of the body as, for example, the nervous system, are having their true cellular nature for the first time revealed; the structural basis of the intrinsic mechanisms of individual cells is in process of demonstration; the relations of the basis in one cell to that in other cells are being found out. Physiology, so long interested in the hydraulic principles of the circulatory apparatus and the muscle-nerve preparation, is being diverted into new channels of research, utilizing in its experiments the newly discovered principles underlying chemical and physical phenomena. The oxygenating and reducing processes which occur in the body, the various stages of anabolic and cata-

bolic metabolism, the phenomena of secretion and excretion, the interrelations of the various bodily activities, the functions of the different neural complexes, the mechanisms of defence and adaptation—these are some of the subjects with which physiologists are now busying themselves.

In pathological anatomy and physiology just as strenuous efforts are being made as in the other fundamental departments. Our ideas concerning inflammation have been so much modified that we are advised by some of the ablest pathologists to give up the term altogether. The nature of inflammatory exudates is still under discussion; what elements are of hæmic and what of local origin are disputed; the great cleft between the acute inflammations and the chronic processes associated with production of new connective tissue is still unsatisfactorily bridged. The ætiology of tumors, as yet unsolved, stimulates the embryologist on the one hand and the parasitologist on the other to renewed exertion. New tumors are being discovered; old ones are being regrouped; finer and finer distinctions between benignancy and malignancy are being drawn with results eminently satisfactory for the practical surgeon.

The therapeutic hopelessness that pathological anatomy inspires is more than compensated for by the faith in the future of therapy and prophylaxis directly derivable from a consideration of the teachings of pathogenesis. As pathological processes are traced further and further back to the earliest stages when function begins its deviation from the normal and the causes underlying those deviations gradually become recognizable the means of prevention and the indications for treatment become obvious.

Bacteriology appears to have done for us the greatest work of which it is directly capable; further advances in a similar direction promise to be made rather through the aid of chemistry and physics. The study of protozoan invasions is yet in its infancy and may have surprises in store for us. One cannot help but feel that we are on the brink of the discovery of the infectious agent in syphilis and the infectious fevers, but who can prophesy what the nature of the agent will be—animal, vegetable or less highly organized "ferment."

We have some reason to be proud of the present status of public hygiene. There never was a time when the general public was more industriously educated concerning the importance of hygienic measures than at present—never a time when the laity was more thoroughly exercised over this topic. Sanitary associations are innumerable; public health departments are everywhere demanded. Meat, milk and vegetables are inspected; impurities in food and drink are more and more excluded through the vigilance of the law. Contagious diseases are diagnosed early and isolated by city officials. Governmental sanatoria are in sight. Quarantine and disinfectant measures are more rigidly and fortunately more intelligently employed than ever before. Great epidemics are being choked at their starting places, the only mode in which they can satisfactorily be combatted. A fire can be extinguished by a fire department in its incipient stage—once well

under way it is beyond the control of human interference. There is good prospect that ere long the world will be through with those tremendous outbreaks of contagious disease of bacterial origin which from time to time have so devastatingly swept over both Western and Eastern civilizations. Thanks largely to Anglo-Saxon enterprise the back yards of the world in which the embers of epidemics smoulder are being rapidly cleaned up; this together with the rendering ever more infection-proof of the materials to which the flame of infection spreads bids fair to make the whole subject if not entirely, at least largely, a matter of history.

The present position of personal hygiene is a subject upon which we have less reason to congratulate ourselves. In principle we know much, in practice we do but little. Concerning climate, fresh air, diet, clothing, bathing, work, rest and recreation there is perhaps less dearth of information than negligence and inattention in performance. We behave hygienically when we are forced to do so, but not as a well planned order of life. Above all on this continent we have as yet to learn how to live and the problem here is less simple than elsewhere, for life here, especially in the great centres, is life at its most complex. Nowhere else is the strain so great—nowhere else does it so rapidly increase in tension. It must be a nervous system other than that which has been and that which is that will stand it. That nervous system may be now evolving, but in the meantime the unfit are succumbing in numbers ever more alarming. Moderation in all things and elimination of the non-essential from our lives would do much to tide us as a race over the transition period.

Perhaps the most significant movement at present observable in medicine is the beginning of the application of the newer ideas of physics and chemistry to the solution of biological questions. One has ever to be on his guard lest he expect too much from the introduction of new methods of approaching problems, but in this instance the principles underlying are so fundamentally important and have already worked such marvelous transformations in the mode of thought and activity of chemists that we are justified in expressing great hope for the future in their use by medical investigators. The doctrines of van't Hoff and Arrhenius are pregnant with great possibilities. van't Hoff's brilliant generalizations with regard to the behavior of solutions are found to hold good by a whole series of workers—the laws of osmotic pressure appear to be strictly analogous to the laws of Boyle, Gay-Lussac and Avogadro concerning gases. The theory of the dissociation of electrolytes—salts, acids and bases—into their components, the ions (cations and anions), which we owe to Arrhenius, affords a satisfactory explanation of an enormous number of facts hitherto unintelligible. These newer doctrines not only correlate facts hitherto unconnected, but they have shown the way to new lines of experimentation and have acted as a most powerful stimulus to original research. While it is probably not true that chemical activity is due solely to ions and never to whole molecules, yet the number of chemical reactions which according to the physical chemists are purely

ionic is very great, including certainly the majority thus far investigated. The studies of Kahlenberg and True on the toxic effects of acids and bases on plant life indicate that it is the hydrogen ion of the acid and the hydroxyl ion of the bases which is the active constituent. The significant experiments of Loeb on the power of muscle to absorb water in the presence of acids suggest the value of the physical-chemical method of thought in physiology. The work of Krönig and Paul upon the effects of disinfectant substances has made probable the ionic nature of this influence. The introduction by Dreser of the conception of the osmotic work done by the kidney and a calculation of the same in foot pounds is of the deepest interest, even if his interpretation of his results, as it would appear, has to be somewhat modified. The practical results in sight from the clinical studies by the method of physical chemistry undertaken by Hamburger, Köppe, Koranyi and others are being thankfully received by clinicians all over the world. Loeb of Chicago has recently interested us by proving the poisonous effects of pure solutions of common salt, and though his experiments have been upon lowly organisms, I should consider the medical man rash who continued to give a patient of low vitality large doses of ordinary salt solution when he can just as well introduce a solution in which the holding in a variety of salts corresponds more nearly to that of normal serum. Almost startling, too, is the assertion of Loeb that the eggs of echinoderms can be fertilized in the absence of spermatozoa by magnesium ions. If the phenomenon of fertilization—that *sanctum sanctorum* of physiological processes begins to be invaded by physical chemistry—what may we not expect from that science in the future. It would take too long to refer to other work in this field—to the constant reciprocal relation existing between chlorides and achlorides of the blood and urine, to the newer ideas on the occurrence of oedema, to the speculations concerning so-called ion-proteins. Suffice it to say, that the promise for the future in pathogenesis and in pharmacodynamics is much brightened by the advent of physical chemistry. Were a medical student, suited by heredity and environment to look forward to the higher things in medicine, to ask me the question, "How can I best fit myself to make real advances in knowledge in medicine and therapy during the next twenty-five years?" I should say, "In addition to a thorough medical course, arm yourself with sufficient mathematics and gain a thorough theoretical and practical training in the methods of physics and chemistry and especially in the principles and methods of what is called 'physical chemistry.' After this turn your attention to the solution of medical problems." Not that the doctrines of van't Hoff and Arrhenius will be able to clear up all difficulties—the doctrines themselves may even be found to be only helpful hypotheses and later be supplanted by others less faulty,\* but all our knowledge is but relative, and at present new knowl-

\* Some physicists are inclined to believe that the "corpuscular" doctrine advanced by J. J. Thomson seriously threatens the position of the ion-conception.



edge can probably be easiest reached by working with the methods referred to.

The conviction is not infrequently expressed that surgery having gone so far cannot have many great conquests still before it, but when we review recent progress it would seem hazardous to deny the possibility of still more interesting advances. The extensive use of local anæsthesia since the introduction of cocaine in 1884 has led to striking modifications in surgical technique. The general narcosis produced by ether and chloroform together with perfected hæmostatic methods has a tendency to encourage slow operations. With cocaine anæsthesia and infiltration of the tissues with nearly indifferent fluids surgeons have again been compelled to operate more quickly and with greater efforts at precision. The discovery of the X ray has made bone surgery much more accurate work than it could ever have been before. Most noteworthy, perhaps, in modern surgery, are the operations which are now undertaken upon the liver, gall-bladder and bile ducts. These together with gastrointestinal surgery have elevated abdominal surgery to even a higher rank than that attained by pelvic surgery through the activity of the gynæcologists. Progress can certainly be expected still in the treatment of surgical diseases. Max Broedel in Kelly's service has just shown us by a study of its blood-vessels the safest way to cut into the pelvis of the kidney.

The sharp line between medicine and surgery is breaking down. The two domains overlap at their boundaries and the importance of medical men and surgeons working together is becoming more and more appreciated. The establishment of a journal, the *Mittheilungen aus dem Grenzgebiete der Chirurgie und Medizin*, is an indication of the feeling which exists. The surgery of the future aside from emergency cases will be largely done in hospitals. Surgeons, to attain the necessary technical skill and familiarity with normal and pathological living tissues, must stand for years over an operating table. A trained corps of assistants and nurses is essential for the more difficult problems which now fall to the lot of the surgical specialist.

Compared with the brilliant achievements of the surgeon the therapeutic efforts of the physician are felt by most medical men as well as by the laity to be somewhat disappointing. In spite of the extraordinary keenness of diagnostic power which has been developed in internal medicine the painfully exact studies in pathological histology and in physiological and pathological chemistry, the wide-spread activity in pharmacological and pharmacodynamical experiment and the indefatigable efforts of the manufacturing chemist to supply new drugs, the view is prevalent and rightly so that in the treatment of internal diseases "we have more to hope for the future than to entrust to the present." The explanation is obvious. The age is one of doubt. Authority now less than ever before counts for anything. There is a lively fear of empiricism, an insatiable desire for rational explanation. Pathological anatomy stimulated to brilliant diagnosis, but, for a time at least, it encouraged therapeutic pessimism.

Skoda, the type of a therapeutic nihilist even went so far as to say "we can diagnose disease, describe it and get a grasp of it, but we dare not expect by any means to cure it." In such a temper drugs of unknown physiological action cannot conscientiously be set to act upon bodily tissues in disease in which we are ignorant of the deviations from the normal of the chemical and physical processes going on in the cells. The death blow came first to polypharmacy; to-day, with many physicians, pharmacotherapy, as a whole, is almost moribund. Ask the prescription chemist how his work now compares with that of fifteen or twenty years ago. He will tell you that he is lucky if he fills ten recipes to-day, where he formerly filled a hundred. The druggist in the village or small town may still receive an occasional prescription which orders ten or fifteen varieties of herbs, but the fine old concoctions know to our fathers have almost entirely disappeared. It is seldom in this day that more than one or two drugs are prescribed at one time and these too often because "the patient must have something." A dozen drugs altogether suffice for the pharmacotherapeutic armamentarium of some of the most eminent physicians on this continent.

The reaction against the use of drugs, together with the development of the expectant method of treatment, permitted of a more accurate study of the natural cure of the disease than was before possible. Consistent homœopaths who pushed their minimal dosage to such a degree that any conceivable drug effect was prevented did much, though unintentionally, to illustrate the healing power of nature unaided. Dietl's studies of pneumonia, treated without blood-letting, convinced him and the world that the effects of therapeutic interference in this disease had been greatly over-estimated.

Marked as have been the advantages derived from these therapeutic revolutions I cannot help but feel that the time has come for a more hopeful outlook for therapy in internal medicine. More thought among the best men might with advantage be given to it. Not that a whit less attention should be given to diagnosis or to pathological study—only through these is a successful therapy thinkable—but may we not interest ourselves more in the therapeutic measures of proven value which are really at our disposal. I am fully aware that some practitioners fail to properly diagnose their cases, that there are those who have but little scientific knowledge of disease, and it is these usually who possess the largest magazines of misplaced confidence in drugs. It may even be said to be certain that the majority of men in practice who leave it temporarily to undertake post-graduate work, would be benefited more by instruction in the wealth of diagnostic aids recently put at our disposal than by a course in therapeutics. That the skilled diagnostician, however, can be of greater service to his patients if he put the same keen, well-directed intelligence into motion with regard to treatment that he uses in diagnosis instead of stopping short at the diagnosis and shrugging his shoulders when therapeutic effort is mentioned, must be patent. As Leyden puts it: "The task of therapy is to help the patient as far as is possible with the



means at its disposal at the time; it dare not postpone the treatment to future discoveries. Specific therapy, long looked upon as that alone which is safe and worth striving for, is deprived of its absolute dominion; instead of 'curing diseases,' our task is altered to 'making patients well.'"

I cannot help but think that one of the causes of therapeutic pessimism among the better men in the profession lies in the fact that when therapeutics is spoken of most men call pharmacotherapy disproportionately into mind. It is because they are insufficiently known and appreciated that dietotherapy, climatotherapy, hydrotherapy, kinesiotherapy, electrotherapy and psychotherapy are not ranked with pharmacotherapy, and yet, in the majority of cases with which physicians deal, one or more of these is of far greater importance than treatment with drugs. Psychotherapy especially has a great future. Not until physicians become better psychologists and learn better how to apply psychic methods in the treatment of disease can we hope for the disappearance of such psychic epidemics as that represented by Christian science. In the near future psychopathogenic mechanisms should be carefully studied in order that psychoprophylaxis can have a wider field.

What the future of pharmacotherapy will be who will be rash enough to judge? That it will be great seems certain. That it cannot soon be great seems sure. Synthetic chemistry has supplied us with a host of new bodies for experimentation. Only a very small percentage of these have thus far been found to be of value. Antipyretics, analgesics and hypnotics especially are being multiplied. They have to be slowly tested on animals, then on healthy human beings and last of all on human beings in diseased conditions before their actual value can be ascertained. The effects of drugs like acetone-chloroform and urethane astonish us, however, and whet the appetite for further discovery.

No single system of therapy is likely soon again to hold general sway. *Contraria contrariis* and *similia similibus* have ceased among scientifically cultivated men to be a universal guide of therapeutic action. The biologically fundamental principle of Pflüger and Arndt, namely, that "minute stimuli, excite to vital activity, stimuli of medium strength favor it, strong stimuli inhibit it, strongest abolish it, it being, however, always an individual matter whether a given stimulus will prove to be feeble or one of medium strength or maximal," associated with the Ritter-Valli law that "diseased organs are in a state of heightened excitability" has been made by Oscar Schulz the basis of his "organ-therapy." Very valuable as the concept appears to be, medical men, with a caution born of experience, will be loath to accept it or any other generalization as an all-sufficient maxim.

The revival of organotherapy or opotherapy, as the French designate it, is a marked feature of present treatment. One of the oldest methods, having been employed long before the Christian era, opotherapy began with an attempt to produce an aphrodisiac effect by administering the genital organs of the respective sex to the individual who desired stimulation.

It is rather curious that the present revival was inaugurated by Brown-Sequard, the composition of whose elixir vitae you know. Organotherapy has, however, this time a rational basis in the conception of an internal secretion, deduced by Brown-Sequard from the studies of Claude Bernard. The production of experimental cachexia thyreopriva and the bringing of the proof that the transplanted thyroid would save an animal from the disease suggested the possibility of the use of thyroid substance in myxœdema and cretinism with the marvellous results which most practitioners have by this time been permitted to observe. The chemical analyses of Baumann showed that an iodine compound in the normal thyroid is an important element in the gland.

This "*Parenchymas-therapie*," as Virchow designates it, is obviously a substitution-therapy—a restoration to the diseased body of chemical substances, the removal of which from the normal body gives rise to symptoms of disease. It is in atrophic conditions of the gland that the therapy is valuable. Myxœdema and cretinism are diseases which correspond to the "altruistic atrophy" of Hansemann, while Basedow's disease is thought by many to be an example of "altruistic hypertrophy." Had the principles underlying thyroidotherapy been earlier recognized we should not have expected benefit from the administration of thyroid extract in hypertrophic conditions of the gland.

The French are busy testing the effects of thyroid-therapy on the healing of fractured bones. The experimentation is still in progress and it is too early yet to say much regarding it.

Ponfick's remarkable case, which makes it appear possible that the hypophysis and the thyroid may be compensatory glands, will doubtless stimulate to further study.

With the advent of a successful thyroid therapy, the notoriety hunters soon introduced organic extracts of the most various sorts. Cardin, cerebrin, hepatin were launched and vaunted. Examination of the manufacture of a certain prostate extract showed that it was being prepared from female animals! Such empirical attempts were worse than useless. They represent a return to the primitive.

With certain of the organs we are, however, provided with a rational basis for experimentation. Mering and Minkowski proved the disastrous effects upon the animal of extirpation of the pancreas. The diabetes which followed extirpation could be prevented by transplantation of pieces of pancreas. Yet for reasons not satisfactorily understood pancreas therapy has not been made practically useful.

Again, the effects of removal of the adrenals have been carefully studied. Addison's disease is believed to be largely the result of loss of adrenal substance. Unfortunately, the administration of adrenal extract, while it may alleviate some of the symptoms of Addison's disease, has no effect on the others. The attention paid to the adrenal of late by physiological chemists has, however, been most fruitful. The studies concerning the blood-pressure raising constituents are extremely valuable. The active substance has been isolated

and its chemical nature studied. The work of Abel and others upon epinephrin is furnishing most interesting data for future use.

Rhinologists are using adrenal extract as a vaso-constrictor in the nose. Fresh from the German press comes a careful paper by Stoelzner (in Heubner's clinic), detailing a large series of cases of rickets, markedly benefited by adrenal extract. He finds that the cranio-tabes, the sweats, the delayed coming of the teeth, the irritability of the vaso-motor system, the general restlessness and excitability, the curious smell of the urine, are all very markedly improved by the treatment. The softening of the thorax is frequently benefited. The spasm of the glottis and other symptoms of tetany, however, generally appear to remain uninfluenced by the adrenal extract. The improvement can frequently be made out during the first week of treatment. An amelioration of the symptoms goes on rapidly for a few weeks, later on more slowly.

The spleen and bone-marrow extracts which have been introduced increase the white and red corpuscles of the blood, possibly owing to the nuclei which they contain. That hypophysis extract is of no value in acromegaly would not be surprising, if acromegaly should turn out to be, as some investigators believe, rather an instance of "altruistic hypertrophy" in the sense of Hansemann than one of "altruistic atrophy."

One of the most recent advances claimed in opotherapy is the feeding of ovarian substance as a substitution-therapy in cases (1) where the ovaries have been removed at operation, and (2) at the climacteric to relieve the phenomena characteristic of that period. The substance is given in Germany in the form of Landau's oophorin tablets. Loewy and Richter report that this ovarian substance has a remarkable capacity for increasing the oxygenating power of the body-cells in cases in which the ovaries have been removed. Their protocols are very convincing. Whether or not the therapy will be useful in preventing the obesity so characteristic of so many such cases we must wait to see, but the Germans feel confident that it will.

The advances along the lines of opotherapy are sufficiently indicated by the foregoing experiences. Physiology, experimental pathology, physiological chemistry, pharmacology and pharmacodynamics must lead the way.

In the struggle against infectious diseases a rapid extension of the powers of the physician is observable. The resistance of human beings as a whole is being increased not only by the slow method of natural selection, but by a more rapid mode through personal hygiene. Prophylactic inoculations have been multiplied since the work of Pasteur. The cholera inoculation, that for pest and that for typhoid, appear to be valuable. Flexner in Philadelphia is now experimenting with a prophylactic against the bacillus dysenteriae so deadly in its effects in the Philippine Islands and Japan. The introduction of Behring's serum-therapy in diphtheria has undoubtedly greatly reduced the mortality of that disease, indeed, diphtheria is now scarcely a disease to be dreaded. Aside

from the serum against diphtheria, however, there is as yet little of practical value to acknowledge from this side.

The antidiphtheric serum is an antitoxic serum. That introduced against tetanus is also an antitoxic serum. To be ranked with these two is probably also Calmette's serum against snake poison. Tetanus serum is only preventive, not curative, possibly owing to the fact that the antitoxine injected subcutaneously or into the blood cannot reach the toxine when once the latter has combined with the protoplasm of the nerve cells. Even intracerebral introduction of the antitoxine is not fully satisfactory for obvious reasons. All the other sera which have been introduced, namely, those against cholera, the streptococcus, pneumococcus, the bacilli of plague, anthrax and typhoid fever are not antitoxic sera but antibacterial sera. They do not neutralize the poison which the bacteria produce but have the power of killing the bacteria in the body of the patient and of dissolving them up. Not a single one of these sera is as yet practically useful as a therapeutic measure.

Ehrlich's studies make it probable that with these antibacterial sera at least two bodies are necessary for successful action; (1) the *inter-body* or *immunizing body*, and (2) the *end-body* or *complement* (formerly called *adjuvant* by Ehrlich). The latter is present in normal serum and is the true dissolving body, but it can act only when it is bound to the bacterial cell by means of the immunizing body. The antibacterial sera are rich in the immunizing body. It may be possible that they are insufficient owing to there not being enough of the end-body present. Wassermann is now making experiments in this connection. He hopes that by increasing the amount of end-body or complement available that the antibacterial sera may be rendered valuable in the treatment of disease in human beings.

Had not this paper already become too long it would have been interesting to refer to the progress making in the treatment of conditions of auto-intoxication and of the so-called constitutional diseases, but I must forbear.

From what has been said it is obvious that we have no reason to be discouraged as regards the future of therapy, but rather cause for hope and enthusiasm. We have learned the secret of progress and some formulae for daily action. The secret of advance lies in the consciousness of the fact that it is the orderly application of the well-trained intelligence to medical problems that alone yields valuable results—not the haphazard guess work of the ignorant and untrained mind. Prolonged technical education and systematic research lead to therapeutic advance. In daily life, in the application of discoveries already made, the quack and the routinist physician, with the healing power of Nature behind them, will cure many cases, but we can be sure that greater success and especially greater mental satisfaction will attend the efforts of the physician well educated in the various medical sciences who, thinking all around and through his case, arrives at the most accurate diagnosis possible and gives the patient the benefit of a well-planned conscientious treatment, utilizing every means

which will tend to his cure or relief. If this physician have a specific he will be glad to employ it; if radical cure be impossible he will not neglect the palliative; if at last the exitus

lethalis cannot be prevented he will at least see that the end is euthanasic.

## A COMPARATIVE STUDY OF SOME MEMBERS OF A PATHOGENIC GROUP OF BACILLI OF THE HOG CHOLERA OR BAC. ENTERITIDIS (GÄRTNER) TYPE, INTERMEDIATE BETWEEN THE TYPHOID AND COLON GROUPS.

WITH THE REPORT OF A CASE RESEMBLING TYPHOID FEVER, IN WHICH THERE OCCURRED A POST-FEBRILE OSTEOMYELITIS DUE TO SUCH AN INTERMEDIATE BACILLUS.

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The possibility that under varying conditions of environment different characteristics may be acquired by the members of the large typhoid-colon group of bacilli has inclined some investigators to regard them as closely related or even interchangeable organisms. Nevertheless, there are certain forms which possess, as ordinarily encountered, such definite cultural and pathogenic peculiarities, and which have a tendency to retain the same with such a degree of permanency, that they may be recognized as distinct and constant variations. That this applies to *B. typhosus* and *B. coli communis*, the extremes of the group, is too well known to be dwelt upon. There exists, however, intermediate to these forms, one especially recognizable subdivision, the clinical significance of which as a definite type has been much slighted.

The members of this particular intermediate group are bacilli which possess the morphological and motile properties of Eberth's bacillus but differ from this organism chiefly in the fermentation reactions, since they produce gas in the presence of glucose and other more easily fermentable carbohydrates. Their chief distinguishing feature from the bacillus of Escherich, on the other hand, rests upon the fact that fermentation in various media made from milk does not produce sufficient acidity to precipitate the casein, but, on the contrary, the acid production is but a transient process and is followed, in the presence of air, by a prompt (2-3 days) and distinguishing alkalization of the media which furnishes a ready means of differentiation from both the typhoid and colon type.

Herbert E. Durham,<sup>1</sup> in 1898, boldly divided this whole family into three groups as follows:

I. The Eberth group including *B. typhosus* and its near allies.

II. The Gärtner group including *B. enteritidis* and its near allies.

III. The Escherich group including *B. coli communis* and its near allies.

He states in parentheses that the "allies" of the typhoid group are almost unknown,\* while those of groups II and III have never been sufficiently worked out.

In this intermediate or Gärtner group Durham has placed the following organisms: *Bac. enteritidis* of Gärtner,<sup>2</sup> *B. Breslaviensis* (von Ermenghem),<sup>3</sup> *B. morificans bovis* (Basenau),<sup>4</sup> the "Wurstvergiftung" bacillus described by Fischer,<sup>5</sup> *B. Friedebergensis* (Gaffky und Paak),<sup>6</sup> the Cotta "Fleischver-

\* Organisms culturally indistinguishable from *B. typhosus* have been encountered in the surgical laboratory on several occasions during the past two years. These have been obtained from a perirenal abscess, from the urinary bladder and from peritoneal infections of intestinal origin unassociated with typhoid; on one occasion from the lumen of a chronically inflamed appendix. Similar organisms have been met with in the alimentary canal of healthy dogs. We have hesitated to regard these as *B. typhosus* from the absence of a definite reaction with typhoid serum though they are doubtless closely related forms. From what I have seen of Shiga's bacillus dysenteriae, a specimen of which, obtained in the Philippines, was kindly given to me by Dr. Flexner, I should regard it also as an allied form of *B. typhosus*.

<sup>1</sup> Gärtner: Ueber die Fleischvergiftung in Frankenhausen am Kyffhäuser und den Erreger derselben. Correspondenz-Blätter des Allgemeinen ärztlichen Vereins von Thüringen. No. 9, 1888.

<sup>2</sup> Von Ermenghem: Recherches sur les empoisonnements produits par de la viande de veau à Morseele. Travaux du laboratoire d'Hygiène et de Bactériologie de l'Université de Gand. Tome I, fascicule 3, 1892.

<sup>3</sup> Basenau, Fritz: Ueber eine im Fleisch gefundene infectiöse Bacterie. (Bac. morificans bovis.) Archiv für Hygiene. Bd. XX, S. 242, 1894, and XXXII, p. 219, 1898.

<sup>4</sup> Fischer, Bernhard: Ueber einige bemerkenswerthe Befunde bei der Untersuchung choleraverdächtiger Materials. Deutsche medicinische Wochenschrift, Jahrg. XIX, S. 575-598, 1893.

<sup>5</sup> Gaffky und Paak: Ein Beitrag zur Frage der sogenannten Wurst- und Fleischvergiftungen. Arbeiten aus den kaiserlichen Gesundheitsämtern. Band VI, S. 159, 1890. Also Deutsche med. Wochenschrift, Jahrg. XVIII, S. 297, 1892.

<sup>1</sup> Durham, Herbert E.: On the serum diagnosis of typhoid fever, with especial reference to the Bacillus of Gärtner and its allies. The Lancet, Vol. I, p. 154, January 15, 1898.



giftung" bacillus,<sup>7</sup> as well as the organisms described by Gunther,<sup>8</sup> Karlinsky,<sup>9</sup> Kaesche<sup>10</sup> and others.

These bacilli, it will be seen, come almost uniformly from meat-poisoning epidemics which occurred on the continent, and presumably they are the identical organism which Gärtner first described in 1888.\*

Durham further believes that the gas-producing "typhoid" bacilli of various observers almost certainly belong to this group as well, and not improbably also those cases of "septicæmic typhoid fever" of French authors, in which death occurred before typical lesions had appeared and which were supposed to be due to Eberth's bacillus. In other words, there are possibly intermediate gas-producing forms of the typhoid-colon family which may be the cause of infections giving clinical symptoms easily mistaken for typhoid fever. This is of importance in relation to the cases which are to be described later.

Theobald Smith,<sup>11</sup> during his investigations concerning the bacteriology of infectious swine diseases in 1893, had noted the great similarity between *B. cholerae suis* and a variety of

other pathogenic forms among which were Gärtner's *B. enteritidis*, Loefler's *B. typhi murium*, a bacillus found in a mare after abortion, etc. He in consequence has since referred to them as members of the "Hog Cholera Group" of bacilli in much the same significance as Durham uses the term "Gärtner group." Unfortunately, however, owing to what seemed at the time (1885) an advisable change in terminology, the name hog cholera bacillus was given to an organism previously called swine plague bacillus and some misinterpretation has arisen abroad concerning the variety *B. cholerae suis* as it is now recognized in this country, from the confusion in nomenclature resultant to this change.\*

Recent observations by Reed and Carroll<sup>12</sup> have further demonstrated that there is a close biological relationship between Sanarelli's *Bacillus icteroides* and *B. cholerae suis* and through their report has occasioned much discussion,<sup>13</sup> the former organism also doubtless belongs in the group under consideration. Some months previous to their published report, acting upon a suggestion of Dr. Welch, I had found that it was almost impossible to recognize any cultural differences between these organisms and bacilli of the *B. enteritidis* (Gärtner) type which I was studying.†

We thus see that the close biological relationship of many of these organisms has been recognized, though no attempt

\* Die Fleischvergiftung in Cotta. 21 Jahresbericht über das Medicinalwesen im Königreich Sachsen auf das Jahr, 1889, S. 104. Ref. Hygienische Rundschau, 1891, S. 716.

<sup>7</sup> Gunther, Carl: Bacteriologische Untersuchungen in einem Falle von Fleischvergiftung. Archiv für Hygiene, Bd. XXVIII, p. 146, 1897.

<sup>8</sup> Karlinsky, Justyn: Zur Kenntniss des Bacillus Enteritidis Gärtner. Centralblatt für Bacteriologie, Bd. VI, S. 289, 1889.

<sup>9</sup> Kaesche, C.: Zur Kenntniss der Krankheitserreger bei Fleischvergiftungen. Zeitschrift für Hygiene, Bd. XXII, S. 53, 1896.

\* This was found under the following circumstances:

In Saxony a diseased cow had been slaughtered and the flesh sold for food. Fifty-seven people who had eaten of this meat became ill, the severity of symptoms being directly proportionate to the amount consumed and inversely to the thoroughness of cooking. One young working man ate 800 grams raw, and died in about 35 hours. Gärtner isolated from the flesh of the diseased cow and the organs of this fatal case his so-called *B. enteritidis*. Durham himself<sup>12</sup> has encountered the same organism in the liver of a fatal case from an epidemic in England, and he alone among English writers has concerned himself with these infections. In his valuable address<sup>13</sup> given at Oldham in 1898 he lays especial stress upon the importance of *B. enteritidis* as the cause of the various meat-poisoning epidemics and describes his observations on the Chatterton outbreak.<sup>14</sup>

<sup>11</sup> Smith, Theobald, and V. A. Moore: Additional investigations concerning infectious swine diseases. Bureau of Animal Industry, U. S. Department of Agriculture. Bulletin No. 6, p. 10, 1894.

<sup>12</sup> Durham, Herbert E.: An epidemic of gastro-enteritis associated with the presence of a variety of the bacillus enteritidis (Gärtner). British Medical Journal, Vol. II, p. 600, Sept. 3, 1898.

Durham, Herbert E.: An address on the present knowledge of outbreaks due to meat poisoning. British Medical Journal, Vol. II, p. 1797, Dec. 17, 1898.

<sup>13</sup> Bowes and Ashton: An outbreak of Food Poisoning: being a report on 35 cases of veal-pie poisoning occurring in Chatterton. British Medical Journal, Vol. II, p. 1456, Nov. 5, 1898.

\* Kruse in 1896 (C. Flügge, Die Microorganismen, Zweiter Theil, S. 401) describes the present *B. chol. suis* of American writers under the name *Bacillus suispestifer*, which he places in the Hemorrhagic Septicæmia group.

<sup>12</sup> Reed, Walter, and James Carroll: Bacillus Icteroides and Bacillus Cholerae Suis—a preliminary note. The Medical News, Vol. LXXIV, p. 513, April 29, 1899.

<sup>13</sup> 1. Sanarelli, G.: Some Observations and Controversial Remarks on the Specific Cause of Yellow Fever. The Medical News, Vol. LXXV, p. 193, Aug. 12, 1899.

2. Sternberg, Geo. M.: The Bacillus Icteroides as the Cause of Yellow Fever. A Reply to Professor Sanarelli. Ibid. Aug. 19, 1899.

3. Reed and Carroll: The Specific Cause of Yellow Fever. A Reply to Dr. G. Sanarelli. Ibid. Sept. 9, 1899.

4. Novy, F. G.: The Bacillus Icteroides. A Reply to Dr. Sanarelli. Ibid. Sept. 23, 1899.

5. Sanarelli, G.: The Bacteriology of Yellow Fever once More. Ibid. Dec. 9, 1899.

† The culture of *B. icteroides* which was used had been originally obtained from Roux's laboratory and was but one removed from Sanarelli's original organism. Dr. Reed has since kindly furnished me with three varieties of *B. icteroides* obtained from Santiago and Havana. These organisms belong to the Gärtner group and possess no cultural characteristics sufficient to distinguish them from *B. enteritidis* or *B. cholerae suis*. Differences in pathogenic activity in man and animals and in the serum reactions doubtless exist just as do variations in pathogenicity among members of the *B. coli* group, and consequently to state that the hog cholera bacillus is culturally indistinguishable from *B. icteroides* does not seem to me necessarily to indicate that the latter may not be the cause of a specific infection (yellow fever). As will be seen in the experiments on pathogenic action, the serum test alone is a means of distinguishing members of the group and cultural similarities are by no means an indication of equalities in pathogenic virulence.

has been made to classify them on other grounds than variations of pathogenicity in which peculiarity the individual members of a species naturally differ within wide limits, which in no way affects phylogenetic relationship. The variability in nomenclature itself shows how little recognition has been paid to the similarity of cultural as well as of clinical and pathologic manifestations of the members of this intermediate group.

In 1897 Widal<sup>17</sup> described an organism which was isolated from an œsophageal abscess some years after an attack of typhoid fever, and adopting the nomenclature of Gilbert<sup>18</sup> he designated it a "paracolôn" bacillus. With this organism he grouped several others having similar characteristics, as the bacillus psittacosis of Nocard and the "microbe de la septicémie des veaux" of Thomassen.<sup>19</sup> From Widal's brief description it would seem that this organism is a member of the intermediate group under discussion. It was an actively motile bacillus producing no indol and fermenting glucose but not lactose. Widal's claim for specificity of this particular type was based on the definite serum reaction which the patient's blood showed toward the organism.

The terms paracolôn and paratyphoid, however, Durham does not consider at all appropriate, as the members of the group are quite distinct from both *B. typhosus* and *B. coli*.

Gwyn<sup>20</sup> in 1898 reported a remarkable case which occurred in Dr. Osler's clinic and which presented all of the clinical symptoms of typhoid fever, but in which no serum reaction was at any time demonstrable toward the *Bacillus typhosus*. From the blood of this patient Gwyn isolated in pure culture an organism having cultural characteristics akin to the Gärtner group, and which under the influence of Widal's terminology he designated as a "paracolôn." Toward this organism the patient's serum had an agglutinative reaction in further evidence of the infection. The failure on repeated examinations to demonstrate any serum reaction toward *B. typhosus* was of course not conclusive evidence of the absence of typhoid fever, but the query was naturally raised whether the clinical symptoms could not have been due entirely to an infection with the isolated "paracolôn" alone. Of the several hundred cases of typhoid fever which have occurred in Dr. Osler's service since the employment of the Widal-Gruber reaction has become a routine measure of confirming diagnosis, only a few individual cases have failed to show a definite agglutinative reaction toward *B. typhosus*. It is not impossible that these cases may have represented infections with members of the intermediate group. Durham mentions in his paper a personal experience with an infection resem-

bling a mild typhoid, after which he found a persisting serum reaction toward *B. enteritidis* and which he naturally accredited to a presumable original infection with this bacillus.

A case recently entered the surgical wards (Dr. Halsted's) of The Johns Hopkins Hospital which furnishes the subject of this communication. An organism almost identical with that of Gwyn's and belonging to or closely allied to the Hog Cholera or Gärtner group was isolated from an abscess of the rib which appeared during the convalescence from a prolonged fever of enteric type. That a general infection had occurred was clear from the specific action of the patient's serum toward the isolated organism; there was no agglutinative reaction whatever evidenced toward *B. typhosus*. Whether this infection was of intestinal origin and occurred through the atrium afforded by typhoid lesions or whether it was in itself the cause of the fever, must remain undecided, though it seems from these two cases not impossible that a prolonged fever with the clinical picture of typhoid may be induced by the members of this intermediate group. Had there been a mixed infection, one would have expected a double agglutinative reaction which was not present.

#### CLINICAL SUMMARY.

*Typhoid fever (?) with relapse. Costochondral osteomyelitis during convalescence. Abscess with rupture six months later. Persisting sinus for three months, showing pure culture of intermediate bacillus at operation.*

CASE. Surgical No. 8753. M. Burley, colored, aged 27, was admitted into Dr. Halsted's service, March 1st, 1899, with the following history: From early in June, 1898, nine months before admission, he had suffered with a prolonged course of fever extending over a period of ten weeks. A note from his physician, Dr. Hammond, of Jessups, Maryland, describes the case as one of typhoid with a severe but typical clinical course. The history is without particular note except that he had a distinct relapse of the fever which was ushered in by a profuse hemorrhage from the nose. During his convalescence, the patient says that he had noticed two tender nodules near his breast bone, one the size of a dollar, the other somewhat smaller. The latter subsequently disappeared but the larger one increased in size and six months later broke open, evacuating a large amount of pus. Since that time it has continued to discharge, the sinus persisting without tendency to heal permanently, though it has closed on several occasions for a short period.

Examination showed the opening of a sinus, lined by pale granulations and discharging a small amount of pus, situated on a level with the fifth rib at the edge of the sternum. There were slight œdema of the surrounding tissues and tenderness for a few centimetres along the course of the fifth rib. A probe could be inserted for five centimetres downward and to the left about to the junction of the rib and cartilage where a grating bony substance could be felt.

The patient's physical examination was otherwise negative.

<sup>17</sup> F. Widal: Séro-réaction dans une infection à paracolobacille. La Semaine Médicale, 4 août, 1897.

<sup>18</sup> Gilbert: De la Colibacillose. Semaine Médicale, 1895, p. 1-3.

<sup>19</sup> Thomassen, M.: Une nouvelle septicémie des veaux. Annales de l'Institut Pasteur, Tome XI, p. 523, 1897.

<sup>20</sup> Gwyn, Norman B.: On Infection with a Paracolôn bacillus in a case with all the clinical features of typhoid fever. The Johns Hopkins Hospital Bulletin, Vol. IX, p. 54, March, 1898.

No clumping reaction could be demonstrated toward *B. typhosus* with the patient's serum.

**Operation** March 6th, 1899. The sinus and surrounding tissues, with a button of chest wall including the cartilage of the adjoining ribs were excised and the wound closed over a blood clot by a plastic skin flap.

The tissues removed consisted of the cartilage and portion of bone of the diseased rib. A cavity measuring about one cm. in diameter lined with pale granulation tissue was situated in the cartilage near the end of the bone. A sinus led from this through the cartilage toward the sternum. No bone formation could be demonstrated in this cartilage. The cartilages of the adjoining ribs (6th and 7th), portions of which were excised as described, showed marked evidence of beginning ossification as a fine network of new bone-formation preventing easy section with the knife.\*

Cultures were taken at the operating table from the bottom of the sinus immediately on making the first incision into it. These cultures showed a pure growth of a bacillus which fermented glucose and did not coagulate milk. Appreciating the rarity in such situations of bacillary forms other than *B. typhosus*, the organism was carefully examined with the results to be appended, namely, its identification as a member of the intermediate, the Hog Cholera or Gärtner group. For convenience this bacillus will hereafter be called *Bacillus O*.

#### Agglutination reactions with the isolated organism.

The following early observations upon the agglutinative reactions of the patient's serum toward the isolated organism and toward other members of the typhoid-colon family which were at hand, as well as a comparison with the reactions of sera obtained from other sources toward these same organisms were kindly made for me by Dr. Gwyn. Unfortunately, at this time the relation of *B. chol. suis* and *B. icteroides* with the organism in question was not recognized, and not until later did I come into possession, through the courtesy of Dr.

\*It is noteworthy that postenteric and traumatic osteomyelitis in children almost invariably have their starting point in the epiphyseal ends of the long bones of the extremities, while only in adults do we find similar processes originating at the costochondral articulations. The natural explanation seems to be that the seat of most active bone-formation is especially susceptible to infectious processes. In adults the cartilages of the ribs represent practically the only situation where ossification in cartilage is taking place. The occasional seat of post-typhoidal infection in the thyroid cartilage of adults may be accounted for in similar fashion. In a post-typhoidal case operated upon two years ago at this hospital by Dr. Finney, I had an excellent opportunity of examining the tissues, since there had been no preformed sinus and the infected area with portions of the two neighboring ribs had been removed *in toto*. The abscess had apparently started in the cartilage of the sixth rib close to the rib itself, where ossification, as was seen by comparing sections of the cartilages of the adjoining ribs, had been in progress. A pure culture of *B. typhosus* in this case was obtained from the cavity in the cartilage.

Durham, of Gärtner's bacillus, *B. moribificans bovis* (Basenau) and the variety "Hatton" which Durham has described. When these organisms were received, three months after the operation, I found that the patient's serum had so far lost its reaction toward the intermediate bacilli that the results were unsatisfactory for comparative purposes and none of the original serum had been saved. This, however, was compensated for by comparing results with the serum obtained from an immunized animal, as will be described later.

(A) Effect of a variety of sera upon *Bacillus O*, the organism isolated from the abscess.

I. Reactions with patients' serum. Two observations with 10-hour cultures showing active motility. A marked immediate reaction\* occurs in slight dilutions, with instant cessation of motion and the formation of large clumps, in  $\frac{1}{2}$  to 2 minutes. Reaction is slower but distinctly marked in a 1-800 dilution in two hours.

II. Reactions with other agglutinating sera. Typhoid sera, A., B. and C., agglutinating *B. typhosus* in dilutions of 1-400. All were quite negative in dilutions of 1-10 in two hours. The motility in all cases was but slightly if at all affected.

III. Reactions with sera of healthy individuals. Five normal sera were tried in dilution of 1-10. The reaction was absolutely negative in all cases.

(B) Effect of the patient's serum upon other agglutinable organisms of the typhoid-colon group.

I. *Bacillus typhosus* reacting well to typhoid serum in dilutions of 1-200 and 1-300. Little or no effect upon motility in two hours in dilution of 1-10.

II. *B. coli communis*. Six varieties from stock cultures of the pathological laboratory.

				Well marked clumping. Motility not absolutely stopped in two hours.
A.	Motility active.	Dilution	1-200	
B.	Motility slight.	Dilution	1-50	Fair reaction in two hours.
C.	" very sluggish "	"	1-10	Fair reaction in one hour.
D.	" " " "	"	1-10	No appreciable effect in one hour.
E.	" " " "	"	1-10	
F.	" " " "	"	1-10	

III. *B. Paracolon* (Gwyn). Motility very active. Dilution 1-10. Slight evidence of reaction. Cessation of motility.

\*For a reaction to be positive we understand that there must be a complete cessation of motility, with clearing of the field of individual organisms and the formation of large clumps. The figures may seem low, but "a reaction" is looked upon very critically.



(C) Comparison of the effect of the typhoid and normal sera used in (A), II and (A), III upon these same organisms of (B).

	Typhoid serum.	Normal serum, a.	Normal serum, b.
B. typh.	1-300 Positive.	1-10 Negative.	1-10 Negative.
B. coli A.	1-100 Positive.	1-10 Positive.	1-10 Positive.
B. coli B.	1-50 Suggestive.	1-10 Suggestive.	1-10 Suggestive.
B. coli C.	1-10 Negative.	1-10 Suggestive.	1-10 Negative.
B. coli D.	1-10 Suggestive.	1-10 Positive.	1-10 Positive.
Paracolon			
(Gwyn)	1-10 Negative.	1-10 Negative.	1-10 Negative.

These results show the absence of any reaction on the part of the patient's serum toward *B. typhosus* or toward any other organism tried except an occasional variety of *B. coli*. It is, however, a not uncommon observation to find an agglutination reaction toward colon, since sera from apparently healthy individuals, as the above results demonstrate, often react in some degree toward members of the colon group, doubtless from the more or less frequent slight colon infections which occur in the course of occasional mild enteritides. In the absence, therefore, of a double agglutination reaction we may with propriety exclude the possibility that the infection with *Bac. O* was superimposed upon a typhoidal infection and that the former organism and not *B. typhosus* was responsible for the clinical symptoms.

#### Note on the Pathology and Bacteriology of the Lesion.

The isolation of this organism from an osteomyelitic process secondary to an enteritis and the positive agglutination reaction of the patient's serum toward it are conclusive evidence of a peripheral septicæmia, such as frequently occurs during the progress of enteritides occasioned by *B. typhosus*. It is, of course, possible that many of these intermediate organisms may have their habitat at one time or another in the intestine and, through the atrium afforded by lesions such as occur in typhoidal enteritides, they may enter the portal circulation, or, indeed, by way of the thoracic duct, the peripheral circulation, provided they are not checked by the mesenteric glands. Thus a peripheral septicæmia, such as in typhoid fever frequently occurs from an invasion with the specific organism of the disease itself, may supposedly be occasioned by the entry of any intestinal bacterium. Such a secondary invasion Dr. Welch,<sup>21</sup> in 1890, demonstrated to be possible with *B. coli*, but it has been a common observation that in such superimposed colon infections the organisms only exceptionally pass beyond the confines of the abdominal cavity.\* It is therefore exceedingly unusual to find in peripheral post-typhoidal lesions organisms of intestinal origin

other than the typhoid bacillus itself, though complicating pyogenic skin (coccal) organisms are common. The abdominal complications, occurring in the liver and gall-bladder, for example, by way of the portal circulation are, on the other hand, frequently due to such secondary invasion. For these reasons, as well as those given above, it seems unlikely that *Bac. O* was such a secondary invader. In suppurative sequelæ, in bone especially, it has been exceptional, if we may draw conclusions from such lesions as have occurred secondary to typhoidal enteritides, to find intestinal bacilli other than the specific organism of the disease. As has been stated, the latter is frequently present in the peripheral circulation and, as Quinke<sup>22</sup> has demonstrated, it finds the bone-marrow a habitat of especial predilection. Of the fifty-one cases of post-typhoidal bone lesions which Keen<sup>23</sup> collected, and in which authentic bacteriological studies had been made, thirty-eight were associated with a pure or mixed infection with *B. typhosus*. In only one case was there a supposed mixed infection with *B. coli*, which naturally would be the most common secondary invader. This was a case of Klemm's.<sup>24</sup> Déhu<sup>25</sup> (1893) in his elaborate statistics stated that *B. coli* had never been seen in bone abscesses and without excluding the possibility of its occurrence he regarded it as extremely improbable that the colon bacillus held any relation to the production of osteitides.

Recently Blumer<sup>27</sup> has reported a case in which *B. coli* was supposed to have been isolated from a post-typhoidal rib abscess. His organism, however, was an alkali-producer in milk and therefore probably did not ferment lactose and should hardly be regarded as a colon bacillus. No mention occurs of serum reactions in his report, and it is quite possible that the organism isolated was the specific cause of the fever preceding the osteomyelitis and was a member of the group in question.

#### BACTERIOLOGICAL SURVEY OF THE BACILLUS. (*Bac. O.*)

For purposes of comparison inoculations were made upon all media, with the following organisms:\*

<sup>21</sup> Quinke, H., and A. Stühlen: Zur Pathologie des Abdominal typhus. Typhusbacillen im Knochenmark. Berliner klinische Wochenschrift, Bd. XXXI, No. 15, p. 351. April 9, 1894.

<sup>22</sup> Keen, W. W.: Complications and Sequels of Typhoid Fever. Philadelphia, 1898, p. 113.

<sup>23</sup> Klemm: Quoted by Keen, op. cit., p. 113.

<sup>24</sup> Déhu, Paul: Etude sur le rôle du bacille d'Eberth dans les complications de la fièvre typhoïde. Thèse de Paris, 1893, p. 91.

<sup>25</sup> Blumer, George: A Case of Post-typhoid Bone Inflammation due to the Colon Bacillus. The Pacific Record of Medicine and Surgery, Vol. XIII, p. 105, November 15, 1898.

\* 1-2-3-4-5-9-10-11 were obtained through the kindness of Dr. Harris from the laboratory stock cultures. To Dr. Harris and his assistants, Mr. Winnie and Mr. Holden, I am indebted for confirmation in some of these observations. 6-7-8 were obtained from Cambridge through the courtesy of Dr. Herbert E. Durham. Three additional varieties of *B. icteroides* from different sources were kindly sent to me by Dr. Reed from Washington.

<sup>26</sup> Welch, Wm. H.: The Bacillus Coli Communis: the Conditions of its Invasion of the Human Body, and its Pathogenic Properties. Medical News, Vol. LIX, p. 669, Dec. 12, 1891.

\* This has been discussed in a recent paper.<sup>26</sup>

<sup>27</sup> Observations upon the Origin of Gall-Bladder Infections and upon the Experimental Formation of Gall Stones. The Johns Hopkins Bulletin, Vol. X, Nos. 101-102, p. 166, 1899.

1. *B. typhosus* (a), an early alkali-producer (3 weeks);
2. *B. typhosus* (b), a late alkali-producer (months);
3. *B. coli communis* (a), var. not fermenting saccharose;
4. *B. coli communis* (b), var. fermenting saccharose;
5. *B. paracolon* (Gwyn);
6. *B. enteritidis* (Gärtner);
7. *B. moribificans bovis* (Basenau);
8. *B. var.* "Hutton" of Durham;
9. *B. cholerae suis*;
10. *B. icteroides* (Sanarelli);
11. *B. typhi murium* (Loeffler);

thus giving a variety of intermediate forms, as well as the chief variations in the extreme groups of colon and typhoid.

MORPHOLOGY, ETC.—*Bacillus O* could not be distinguished from the typhoid bacillus in form or staining qualities and its description is therefore unnecessary. It decolorized by Gram. Variations in size were observable upon different media and occasionally sedimenting organisms were found to take a bipolar stain. Flagella in number and distribution resembled those of *B. typhosus*. Twelve to fourteen were counted on some specimens and occasionally exceedingly long terminal flagella were observed. Of the above bacilli it is possible that Basenau's organism (No. 7) alone could have been distinguished from the rest with any degree of probability. The variety which Dr. Durham had presented tended to grow in filamentous forms quite recognizable upon most media.

Active motility was present with all varieties except those of *B. coli* which, under the same cultural conditions, showed very sluggish movements, or no motility whatever. The motility of *Bac. O* was especially active, being darting in character, and remained present for many days.

AGAR AND GELATIN.—The appearance of colonies and of the surface growth upon these media presented no features by which they could with any certainty be distinguished. All were very typhoid-like, the luxuriance of surface growth depending somewhat upon the initial reaction. Basenau's organism again is perhaps an exception, as the surface colonies on gelatin presented a more irregular fringed edge than the others which ordinarily showed a pale brownish-yellow centre fading toward the periphery; this was usually slightly scalloped, well defined and almost colorless.

GROWTH IN BOUILLON.—*Bacillus O* and Gwyn's "paracolon" in bouillon and similar media grew much less luxuriantly than did the various intermediate forms used for comparison. The hog cholera and Gärtner type cloud the media very rapidly and more abundantly than *B. coli*, and usually a surface pellicle is formed which may or may not fall. The former organisms, on the contrary, produce but slight turbidity and thus resemble the typhoid rather than the colon end of the group. One series of bouillon inoculations, the medium having an initial reaction of +1.2 (that is, 1.2 cc. of a normal tenth standard solution of sodium hydroxide

was required to neutralize 10 cc. of the medium), gave after five days of incubation the following reactions:\*

*B. coli* (a).

*Branch.* Slightly cloudy; large bubble of gas. Initial reaction +1.2; terminal reaction +1.6; production of acidity .4 per cent.

*Bulb.* Very cloudy; abundant precipitate; slight pellicle. Initial reaction +1.2; terminal reaction +1.6; production of acidity .4 per cent.

*B. typhosus.*

*Branch.* Very slight cloud; no gas. Initial reaction +1.2; terminal reaction +1.4; production of acidity .2 per cent.

*Bulb.* Slight cloud; slight precipitate. Initial reaction +1.2; terminal reaction +1.4; production of acidity .2 per cent.

*Bacillus O.*

*Branch.* Very slight cloud; small bubble of gas. Initial reaction +1.2; terminal reaction +1.3; production of acidity .1 per cent.

*Bulb.* Slight cloud; abundant precipitate; no pellicle. Initial reaction +1.2; terminal reaction +1.0; production of alkalinity .3 per cent.

*B. Gärtner et al.*

*Branch.* Very slight cloud; small bubble of gas. Initial reaction +1.2; terminal reaction +1.4; production of acidity .2 per cent.

*Bulb.* Very cloudy with abundant precipitate and pellicle. Initial reaction +1.2; terminal reaction +0.9; production of alkalinity .5 per cent.

It is thus seen by the cloudiness of the closed arm and by the acid produced that a carbohydrate present in ordinary bouillon permits all of these organisms to grow anaerobically. The intermediate (Gärtner) and colon forms with their allies produce a small amount of gas. The aerobic growth in the open bulb remains acid in the case of colon and typhoid but produces with the rapidly growing Gärtner type some degree of alkalinity, which in a short time is sufficient to overcome the preliminary acidity.

GROWTH IN DUNHAM'S SOLUTION AND DEXTROSE-FREE-BOUILLON WITH INDOL REACTIONS.—In *dextrose-free-bouillon* the vigor of growth of the Gärtner-Hog Cholera type is especially well shown, the great cloudiness and rapid formation of surface pellicle, most marked with *B. typhi murium* and *B. morib. bovis*, being very characteristic. *Bac. O* and Gwyn's organism here again grow much more like the typhoid

\*The percentage of reactions given throughout this paper represents the amount of normal sodium hydroxide or oxalic acid solution requisite to neutralize, by the phenolphthalein test, 10 cc. of the fluid in question. For the purpose of titration normal tenth solutions were used. In all cases an uninoculated control, having undergone corresponding incubation and exposure, was similarly tested to give the initial reaction. As recommended by the committee of American bacteriologists,<sup>28</sup> the plus and minus signs are used to indicate respectively acidity and alkalinity.

<sup>28</sup>Procedures Recommended for the Study of Bacteria: Submitted to the American Public Health Association in Phila., Pa., Sept., 1897. Rumford Press, Concord, N. H., 1898.

bacillus. The same may be said of their growth in *Dunham's solution*.

In the latter medium after seven days incubation no indol could be demonstrated for any of the intermediate forms, while *B. coli* gave its usual marked reaction. Theobald Smith, however, has shown<sup>28</sup> that the carbohydrate which Dunham's peptone solution (generally used for this test) contains, exercises a restraining action on the production of indol, while in dextrose-free-bouillon \* there is no such retardation. A careful test, therefore, was made for *B. typhosus*, *B. coli com.*, *Bac. O* and *B. paracolon* (Gwyn) on the principles laid down by Dr. Smith, and by this means very slight traces of indol, not apparent in Dunham's solution, were appreciable for the two latter organisms after the 8th, 9th and 10th days. The method employed was as follows:

Daily, over a period of ten days, four tubes of dextrose-free-bouillon (properly tested for muscle sugar) were inoculated respectively with a typhoid, colon, paracolon (Gwyn) and *Bacillus O* and placed in the thermostat. At the end of this period all 40 tubes were tested at the same time for indol with freshly prepared standard solutions. The colon bacillus showed after 24 hours a faint trace of indol which increased in intensity up to the 10th day. With typhoid no trace was demonstrable. Gwyn's paracolon on the 8th, 9th and 10th days showed a faint trace and similarly *Bacillus O* in the older tubes gave evidence of a slight production of indol, possibly a little more than the paracolon. These reactions were positive, though slight, and might readily have been overlooked on a single tube test. In Gwyn's original report a belief is expressed in the non-production of indol. On another occasion a similar series of inoculations for comparison with the other members of the intermediate group gave no reaction whatever for any of the organisms up to the 10th day. The culture of *Bac. O* used at this time was several generations removed from the original.

Apparently, from Peckham's elaborate observations,<sup>29</sup> the reaction for indol should not be given the prominence in questions of differentiation of bacillary types that has been attributed to it by Kitasato and other writers who have regarded this as a most important and distinguishing characteristic of *B. coli communis*. According to the source of the culture, however, and possibly depending upon the proteid characteristics of the nourishing medium, there is great varia-

bility in indol production, which, if the observations of de Klecki, Dreyfuss, Sanarelli and others are to be depended upon, is in some degree a measure of pathogenicity. Peckham has shown that *in vitro* this property of indol production may be made to vary within wide limits by cultivation on various media. Indeed she has been able to obtain an indol producing typhoid and to cause *B. coli* to lose this property. As ordinarily encountered in the human body, however, *B. coli* produces indol, and the members of the intermediate group under discussion barely appreciable amounts, if any, through the forms *Bac. O* and Gwyn's paracolon were obtained from sources and under conditions which, according to Peckham, would have been most favorable, if the colon observations are a standard, toward the acquisition of this characteristic.

**GROWTH ON POTATO.**—This is a very uncertain means of differentiation. *B. coli* doubtless grows more luxuriantly on this medium and shows more marked chromogenetic properties. All depends, however, upon the initial reaction of the potato. Occasionally the intermediate bacilli have been seen to grow almost like *B. typhosus*, at other times almost as profusely as colon, but on such occasions the typhoid bacillus itself after a longer incubation would present the same appearance. *Bac. O* and *B. paracolon* (Gwyn) behaved like typhoid, *i. e.*, grew more slowly, darkened the potato less rapidly and assumed a yellow color later than the other intermediate varieties. On one occasion a series of inoculations was made on potato which had an initial reaction of + 8.0.\* All of the intermediate forms of Gärtner type gave an abundant, visible, slightly elevated, smooth, glistening, opaque growth of light-yellow color in 24 hours, which deepened in 48 hours, with an accompanying discoloration of the potato. In four days the potato had assumed a dirty-gray color for all these intermediate forms. *B. typhosus*, *Bac. O* and *B. paracolon* growing more slowly finally gave the same appearance in six days or more. At the end of four days in the presence of the Gärtner type the potato had a reaction of - 4.0, thus 12 per cent of alkalinity had been produced by the growth of the organism in this time. The unreliability of the potato reaction is thus exemplified. These intermediate forms, as well as *B. typhosus*, are alkali-producers when grown in the presence of air, and this alone is responsible for the change in appearance of the medium. This may be demonstrated by adding a corresponding amount of alkali to the potato and incubating it for a few hours, when it assumes the same dirty-gray color. *B. coli*, however, produces its abundant growth without formation of alkaline products, the medium remaining free from the discoloration of the alkali-producers.

<sup>28</sup> Smith, Theobald: A Modification of the Method for Determining the Production of Indol by Bacteria. The Journal of Experimental Medicine, Vol. II, p. 543, 1897.

\* For method of preparation cf. Smith, Theobald, Ueber Fehlerquellen bei Prüfung der Gas- und Säure-bildung bei Bakterien und deren Vermeidung. Centralblatt für Bakteriologie, u. s. w. Band XXII, 1897, No. 2/3, S. 49.

<sup>29</sup> Peckham, Adelaide Ward: The Influence of Environment upon the Biological Processes of the Various Members of the Colon Group of Bacilli. The Journal of Experimental Medicine, Vol. II, p. 549, 1897.

\* These reactions were roughly made by titrating 5 cc. of a neutral solution, in which the potato had been shaken up for five minutes, both before inoculation and 5 days after the growth. Presumably this represents but a small measure of the true reaction.



**MILK.**—The reactions in milk and the various media made from it, depending upon the variations in the rapidity and degree of acidulation or alkalization of the medium, constitute one of the most important means of differentiation of members of the typhoid-colon family.

*B. coli*, as is well known, acting upon its carbohydrate constituents, acidulates milk up to the point of precipitation of the casein (6-8 per cent of acidity) in periods varying from two to seven days and at the same time there is a liberation of gas amounting to about 1/6th of the closed arm of a fermentation tube. Here acidulation ceases, the organism dying out or being inhibited in its growth by the acid formed. That the organism is capable of producing a larger amount of acid from the contained carbohydrates is shown by the coagulation of milk which, having acquired a previous alkalinity of 4 per cent from the growth of an intermediate form, is subsequently inoculated with *B. coli*, which not only overgrows the original organism but overcomes its alkali-production and finally precipitates the casein which this had held in solution.

*B. typhosus* also is an acid-producer but, unlike colon, not to the degree of coagulation of the medium. If plain milk requires 6 per cent to completely precipitate the casein, milk in which *B. typh.* has been grown for 48 hours requires but 4-5 per cent. There are varieties, however, which when grown in milk in the presence of air, lose their acid reaction and become neutral or alkaline. Occasionally this is a noticeable and early change, occurring in a few weeks, and has given rise to the name "blue typhoid" from the unusual color which follows its growth in litmus milk. It is a characteristic, however, which seems to belong remotely to all examples of *B. typhosus*.

The intermediate bacilli under discussion have a very different action in milk, namely, that of an early and distinctive alkalization of the medium in the presence of air, which appears after a transient acidity of a few hours. This alkalization progresses up to the point of solution of the casein (about 4 per cent of alkalinity) and thus with the liberation of the fat-globules gives to the medium the peculiar greenish opalescence and translucency which has been said to be characteristic alone (?) of the Hog-Cholera bacillus, but which occurs similarly from the growth of all members of the group and in fact without the bacteria can be occasioned by the addition of a corresponding amount of alkali to the milk. This reaction in the presence of the growing organisms begins to be apparent in about two weeks, that is, sufficient alkali has been produced to partly dissolve the casein and render the milk slightly translucent. After entire solution has taken place (4-6 weeks) the liberated fat-globules, freed of their enclosing casein envelopes, are found floating upon the surface, leaving the medium fairly clear, often with a gelatinous clot at the bottom of the tube, consisting chiefly of a mass of organisms which take a feeble and bipolar stain and are apparently dead. The opalescent medium above contains a comparatively small number of viable evenly staining bacilli.

The accompanying photographs (Plate VIII, Fig. I (a) and (b)) of a series of tubes show the appearance of this reaction in the case of the intermediate bacilli contrasted with that of *B. typhosus*, *B. coli* and a control tube, all of which have retained their original opacity. Boiling has no apparent effect on the milk which has undergone this change.

In litmus milk the transient acid reaction\* and subsequent alkalization are shown by the color changes. The opalizing reaction from solution of the casein, if present, is not apparent in the litmus medium. The bulb of the fermentation tube after a few days acquires a blue color which deepens in time to a dark navy blue corresponding to the color which follows the addition of 4 per cent or more of alkalinity to a control tube. At varying periods, during the activity of growth, at the bottom of the test-tube or in the closed arm of the fermentation tube the litmus becomes reduced and colorless. These reactions all take place more slowly with *Bac. O* and Gwyn's paracolon, and in fact Gwyn did not recognize this terminal alkalinity of milk, which does not occur for 12 to 14 days. The neutralization period for *Bac. O* does not appear till the 8th day. This relative slowness in alkalization should hardly separate these two varieties from the Gärtner or Hog Cholera type any more than that slow production of acidity sufficient to precipitate casein should separate one variety of colon from another which coagulates milk in half the time.

These results may be expressed as follows:

1. Colon acidulates milk up to the point of precipitation of the casein in from 2 to 7 days.

*B. coli*. Seven-day growth in fermentation tube of milk having an initial reaction of +2.2. Total gas  $\frac{1}{8}$ . Coagulation of milk in 2 days.

Reaction { Branch (terminal) + 8.8 less 2.2 = 6.60% acid produced.  
Bulb (terminal) + 8.8 less 2.2 = 6.60% acid produced.

2. Typhoid produces in milk from 1-2 per cent of acidity, not enough to coagulate the medium. In other words, it requires 1-2 per cent less of acidity to precipitate the casein after the growth of *B. typhosus* than in control milk. Further, as Theobald Smith<sup>21</sup> has shown, the addition to milk in sufficient amounts of a carbohydrate, such as dextrose, which can be acted upon by *B. typhosus*, will lead to the coagulation of the medium.

\* This slight early acidification in milk, so rapidly overcome by the production of an alkaline product, is presumably due to the presence in milk of traces of a fermentable substance which Theobald Smith believes to be a second carbohydrate, possibly dextrose. Neither *B. typhosus* nor any member of the intermediate group appears to have any reducing effect upon lactose in otherwise sugar-free media. For this reason the reactions in lactose sugar-free bouillon and in milk are not supplementary as ordinarily supposed.

<sup>21</sup> Theobald Smith: The action of typhoid bacilli on milk, and its probable relation to a second carbohydrate in that fluid. *The Journal of the Boston Society of Medical Sciences*, Vol. II, No. 12, p. 236, June, 1898.

*B. typhosus*. Seven-day growth in fermentation tube of milk having initial reaction of +2.2. No gas. No coagulation.

Reaction { Branch (terminal) + 3.8 less 2.2 = 1.60% acid produced.  
Bulb (terminal) + 3.8 less 2.2 = 1.60% acid produced.

3. The intermediate type produces a transient acidity followed by a marked alkalinity in the presence of air which increases from 0 per cent in 3 days to 4 per cent in two weeks with solution of the casein and the consequent production of partial translucence of the medium. This, however, only occurs in the presence of air. Such opalization does not occur in the closed arm of the fermentation tube. When such a reaction has occurred the addition of 4 per cent of acidity will again render the medium opaque and 10 per cent (6 per cent of acidity must be reached) must be added to precipitate the casein formerly held in solution by the alkali. Thus there is 10 per cent difference of reaction between the point of coagulation produced by the acid of *B. coli* and the point of solution of the casein produced by the alkali of the intermediate group.

*B. Gärtner et al.* Seven-day fermentation reactions with milk of +2.2 initial reaction. Total gas = bubble. No coagulation.

Reaction { Branch (terminal) + 3.8 less 2.2 = 1.60% acid produced  
(cf. *B. typhosus* (2)).  
Bulb (terminal) + 0.2 less 2.2 + 1.6 = 3.60% alkali produced.

3a. The allied forms, *Bac. O* and *B. paracolon* (Gwyn) show a corresponding but slower reaction.

*Bac. O*, etc. Fermentation reaction in plain milk (7 days) with initial acidity of +2.2. Gas bubble +. No coagulation.

Reaction { Branch (terminal) + 3.9 less 2.2 = 1.70% acid produced  
(cf. *B. Gärtner* (3)).  
Bulb (terminal) + 0.6 less 2.2 + 1.7 = 3.30% alkali produced  
(cf. 30% less than with Gärtner type in same time).

#### FERMENTATION REACTIONS WITH VARIOUS SUGARS.

A valuable means of distinguishing varieties of the colontyphoid group lies in their reactions in the presence of various carbohydrates. Theobald Smith regards this process of differentiation as most essential; "a relief from the uncertainty of the usual potato culture and the variable intensity of the indol reaction." The methods which he advocates were adopted and his precautions observed. Several series of inoculations were made with most of the organisms in the list which has been given, in fermentation tubes of sugar-free bouillon containing 1 per cent of glucose, lactose, mannite or saccharose sugars. The rapidity of gas-production was daily registered at the level of fluid in the closed arm; the proportion of CO<sub>2</sub> to explosive gas was finally noted and the reactions of the bulb and closed arm at varying periods were made an object of record and comparison. All of the observations

were made during incubation at a temperature of 37° C. The original bouillon \* in all instances, to insure its freedom from muscle sugar, was tested by inoculation and incubation with a gas-producing organism before its sugar percentages were added.

*Reactions in Lactose.* Owing to the observations of Smith, which have been reviewed above, upon the presence in milk of a fermentable substance other than lactose, some reservations must be made to the common belief in the correlation between the reactions in plain or litmus milk or in the litmus whey of Petruschky,<sup>2</sup> on the one hand, and the reactions occurring in media made by adding the carbohydrate to an otherwise sugar-free bouillon. In consequence of this fact a source of error may creep into the observations upon the fermentation of lactose, since the commercial product made from milk may be adulterated with this second carbohydrate. Similarly, mistakes may arise owing to the ease with which during the sterilization of lactose media some of the carbohydrate may be converted into a simple and more readily fermentable sugar. For this reason preparation in the autoclave should be avoided and the fractional method of sterilization be employed for this as well as for saccharose media. Furthermore, failure to insure complete freedom from muscle sugar in the original bouillon may lead to mistaken observations and it is doubtless due to these possibilities of error that so many conflicting statements are encountered regarding the fermentation of lactose by various bacteria. The accompanying photographs (Plate IX, Figs. 2 and 3), representing series of inoculations into lactose media, show how such erroneous observations may originate. In the series reproduced in Fig. 2 gas production was present in slight amount in all instances except with *B. typhosus*, and was presumably due to some dextrose adulteration. In the latter series, shown in Fig. 3, the original bouillon had not been completely freed from muscle-sugar, fermentation of which gave a small amount of gas. Before the addition of the 1 per cent lactose to the medium used in this series a corresponding amount of gas was produced in it by the inoculation with *B. coli communis*. Fig. 4 represents the typical reaction, *B. coli* alone producing gas from the carbohydrate, the other organisms producing no fermentative change whatever.

In the following table are given the reactions occurring in bulb and branch of the fermentation tube resultant to the growth of these organisms in 1 per cent lactose media. The figures throughout these tables represent the amount of normal tenth sodium hydroxide or oxalic acid solution required to neutralize by the phenolphthalein test 10 cc. of the medium. An uninoculated control was in each instance similarly tested and these results represent the calculated production of alkali or acid. It will be seen that the figures for the intermediate group are practically the same in all cases.

\* For methods of preparation cf. Theobald Smith, p. 546.

<sup>2</sup> Petruschky, Johannes: Bakterio-chemische Untersuchungen. Centralbl. f. Bakteriologie. Bd. VII, S. 1, 49, 1890.

## COMPUTED REACTION\* AFTER 8 DAYS' INCUBATION WITH 1% LACTOSE SUGAR-FREE BOUILLON HAVING INITIAL ACIDITY OF 1.40%.

	<i>B. typhosus</i> (a).	<i>Bacillus O.</i>	<i>B. paracolon</i> (Gwyn).	<i>B. morbil.</i> bovis.	<i>B. var.</i> "Hutton."	<i>B. enteritidis.</i>	<i>B. chol.</i> suis.	<i>B. icteroides.</i>	<i>B. typhi</i> mur.	<i>B. coli</i> comm. (a).	<i>B. coli</i> comm. (b).
Reaction of Bulb .....	Alkaline .40%	Alkaline .95%	Alkaline .90%	Alkaline 1.60%	Alkaline 1.00	Alkaline 1.00%	Alkaline .80%	Alkaline 1.60%	Alkaline 1.60%	Acid 3.60%	Acid 4.2%
Reaction of Branch ....	No change	No change	No change	Alkaline .20%	Alkaline .10%	Alkaline .10%	Alkaline .10%	Alkaline .20%	Alkaline .20%	Acid 3.60%	Acid 3.6%
Total Gas.....	0	0	0	0	0	0	0	0	0	1 2/2 +	3/4
Proportion of H/CO <sub>2</sub> ..	%	%	%	%	%	%	%	%	%	2 + 1	2 + 1

\* The reactions represent the amount of acidity or alkalinity produced, and are computed from the initial reaction.

*B. coli* ferments lactose, producing an equal amount of acidity in closed arm and bulb, and gas composed of CO<sub>2</sub> and an explosive element (hydrogen) in the proportion of 1:2. No acid is produced by *B. typhosus* from pure lactose, despite the fact that ordinary milk is acidulated by its growth. The amount of alkalinity in the bulb, which occurs with this organism as well as with *Bac. O* is slightly less than that which follows the growth of the intermediate bacilli, possibly

owing to the fact that they grow with less luxuriance than the intermediate variety, which, in the presence of air, multiply rapidly in bouillon. Theobald Smith states that alkali production bears a distinct relation to vigor of growth. The slight alkalinity of from .1 to .2 per cent in the closed arm with the more rapidly growing intermediate forms may be due to some interchange of reaction with the very alkaline medium in the bulb.

## COMPUTED REACTIONS IN DEXTROSE SUGAR-FREE BOUILLON HAVING INITIAL ACIDITY OF 1.50%.

	<i>B. typhosus.</i>	<i>Bacillus O.</i>	<i>B. paracolon</i> (Gwyn).	<i>B. morbil.</i> bovis.	<i>B. var.</i> "Hutton."	<i>B. enteritidis.</i>	<i>B. chol.</i> suis.	<i>B. icteroides.</i>	<i>B. typhi</i> mur.	<i>B. coli</i> comm. (a).	<i>B. coli</i> comm. (b).
Reaction of Bulb .....	Acid 3.50%	Acid 3.50%	Acid 3.60%	Acid 3.70%	Acid 3.70%	Acid 3.70%	Acid 3.70%	Acid 3.70%	Acid 3.70%	Acid 3.90%	Acid 3.80%
Reaction of Branch ....	Acid 3.50%	Acid 3.70%	Acid 3.70%	Acid 3.90%	Acid 3.90%	Acid 4.10%	Acid 3.90%	Acid 4.15%	Acid 4.15%	Acid 4.15%	Acid 3.90%
Total Gas.....	0	1/2 - 1	1/2 - 1	1/2 - 1	1/2 - 1	1/2 - 1	1/2 - 1	1/2 - 1	1/2 - 1	1/2 +	1/2 -
Proportion of H/CO <sub>2</sub> ...	%	2 + 1	2/1	2 + 1	2 + 1	2 + 1	2 + 1	2 + 1	3/1	2/1	2/1

*Reactions with Dextrose.* All of the members of the Hog Cholera or Gärtner group produced gas, in correspondence with *B. coli* and its allies, when grown in the presence of dextrose. The total displacement in the closed arm of the fermentation tube was found to vary somewhat under different conditions of inoculation. Two series as represented in the photographs (Plate X, Figs. 5 and 6) are given in illustration of this irregularity. One feature, however, is brought out in each series, namely, the relative slowness of gas-production with the two allied forms, *Bacillus O* and Gwyn's *paracolon*, which in the first twenty-four hours produce less than half as much gas as the other organisms.

*Reactions with Mannite.* Like dextrose, this carbohydrate is readily fermented by the organisms in question (cf. Plate XI) with the production of even a greater amount of gas, which, under some circumstances (cf. Fig. 8), may displace

the larger part of the fluid in the closed arm. In this series *Bac. O* was, as in the presence of dextrose, slow in its liberation of gas. One peculiarity of the reactions with mannite lies in the terminal reaction of the bulb which remains neutral or slightly alkaline, as does the media containing non-fermentable sugars (lactose and saccharose). The proportion of CO<sub>2</sub> in the gas was less than with dextrose, being 1/3 or less of the total amount. In several instances there was failure to demonstrate that the remainder contained any H or other explosive element.

*Reactions with Saccharose.* In the preparation of saccharose bouillon, as well as with lactose, precautions must be taken during sterilization to avoid any conversion of the carbohydrate into more readily fermentable sugars. No gas is produced and no acid formed by any of the intermediate group in this medium. Certain forms of *B. coli* also fail to



ferment saccharose, as is shown in Plate XII, Fig. 9. This has been pointed out by Theobald Smith. Other varieties of colon produce an abundance of gas, as is shown in Fig. 10 (*B. coli* comm. (b)). In the series presented in this latter photograph there had been a slight conversion of the sugar as the medium had been autoclaved. In several instances, consequently, a slight production of gas has resulted, showing the source of error which may result from this method of sterilization. The slowness of the growth of *Bacillus O* and Gwyn's *paracolon* heretofore commented on was shown in the closed branches of these tubes by the tardy reduction and decolorization of the litmus which had been added to the media. This is apparent in the photograph. In the accom-

panying table are given the reactions which occur after growth in saccharose media. It will be seen that the more rapidly growing organisms have produced a greater percentage of alkalinity in the presence of air and that a small percentage (.2 per cent) is present in the closed arm, possibly due as in the case of lactose reactions to some interchange in reaction with the bulb. The initial reaction of the medium in this series was +1.0 and the reaction for the Gärtner or Hog-Cholera type after 9 days when the tests were made was +.8 for the closed arm and -1.4 for the bulb. On the occasions when there was slight gas-production due to faulty preparation of the medium, a sufficient amount of acidity was found to delay alkalization in the bulb.

TABLE OF COMPUTED REACTIONS IN 1% SACCHAROSE SUGAR-FREE BOUILLON.

	<i>B. typhosus.</i>	<i>Bacillus O.</i>	<i>B. paracolon</i> (Gwyn).	<i>B. moribif.</i> (Davis).	<i>B. var. Hutton.</i>	<i>B. enteritidis.</i>	<i>B. cholerae</i> suis.	<i>B. icteroides.</i>	<i>B. typhi</i> mur.	<i>B. coli</i> comm. (a).	<i>B. coli</i> comm. (b).
Reaction of Bulb .....	Alkaline 2.0%	Alkaline 2.0%	Alkaline 2.0%	Alkaline 2.4%	Alkaline 2.4%	Alkaline 2.4%	Alkaline 2.4%	Alkaline 2.4%	Alkaline 2.4%	Alkaline 2.4%	Acid 5.0%
Reaction of Branch .....	Neutral. .....	Neutral. .....	Neutral. .....	Alkaline 0.2%	Alkaline 0.2%	Alkaline 0.2%	Alkaline 0.2%	Alkaline 0.2%	Alkaline 0.2%	Alkaline 0.2%	Acid 5.0%
Total Gas..... (cf. Plate V).	0	0	0	0	0	0	0	0	0	Occasional bubble.	3%
Proportion of H/CO <sub>2</sub> ..	%	%	%	%	%	%	%	%	%	?	2 + 1

Pellicle formed on bulb with 4, 5, 6, 7, 8, 9. Reactions taken on 9th day. Five days of original incubation.

#### SCRAPED-TUBE REACTION.

For the differentiation of closely related bacilli, Achard and Renault<sup>33</sup> originated a method of inoculation of one organism upon a base which previously had served for the growth of another allied form. The development of the growth upon such a substratum was regarded as evidence of individuality and its failure as evidence of identity of the organisms. Many inoculations of this nature were made in the following way: After 72 hours of incubation at 37° C., the growth from the upper half of an inoculated agar slant was carefully removed and the tubes replaced in the thermostat to insure no further growth. Inoculations of these tubes were then made in a single streak along the centre of the area formerly occupied by the original growth and the results recorded after 72 hours of further incubation. How much reliance is to be placed upon this method of Achard is undetermined. Smith<sup>34</sup> does not regard it as an important

criterion, since slightly increased sensitiveness to acids or alkalies which may characterize closely related organisms may affect it.

It can be seen on consulting the table that none of the organisms could furnish a visible growth when reinoculated on their original substratum. In the case of *Bacillus O*, both typhoid and colon grew on its original surface of growth, while none of the allied forms grew with any luxuriance. Gwyn's *paracolon* did not furnish any growth, but on the contrary *Bac. O* grew well upon the substratum of the *paracolon*. Similarly, although *B. coli* grew well upon the base of *Bac. O*, the latter gave no growth whatever on a colon substratum, though this was repeated with eight varieties of colon. It can, however, be said that the members of the intermediate group under most circumstances in which the reactions were tried failed to show on a substratum of one of its allies a growth of any vigor.

#### THERMAL DEATH-POINT.

Tests made by Mr. Winnie to determine the thermal death-point showed that an exposure at 60° C. for five minutes would prevent further growth of *Bacillus O*. A corresponding incubation at 55° C. failed to completely destroy the organisms, many colonies appearing on plate culture. Similarly, after a ten-minute exposure at the same temperature,

<sup>33</sup> Achard et Renault: Sur les bacilles de l'infection urinaire. *Semaine Médicale*, 1892, p. 136. Sur les différents types de bacilles urinaires appartenant au groupe du *bacterium coli*. *Ibid.*, 1892, p. 512.

<sup>34</sup> Smith, Theobald: Notes on the *Bacillus Coli Communis* and Related Forms. *American Journal of Medical Sciences*. Vol. CX, p. 283, 1895.

a number of colonies appeared, though many less than after the shorter period of incubation.

#### PATHOGENICITY.

The object of this study has been merely an attempt at classification, and a lack of correspondence in pathogenic action may be no indication of the absence of phylogenetic relationship. Nevertheless, the following experiments, undertaken with some of these bacillary forms under discussion, are not without their instructive features. Most of the organisms which are members of this intermediate group pos-

sess pathogenic properties of considerable virulence toward animals and may be the occasion of epidemics in hogs, cattle and other live stock, mice, birds, etc., and toward man as well as animals, as is evidenced by the various epidemics of meat-poisoning, yellow fever, etc.

Pathogenic experiments have never been undertaken with Gwyn's *paracolon*, and the notes concerning *Bacillus O*, found under somewhat similar circumstances in a case clinically one of typhoid fever, show that its virulence toward the lower animals in the condition of its isolation was not an intense one, but resembled the action of *B. typhosus* rather than that of other members of the Gärtner or hog-cholera group.

SUBSTRATUM OF—	TRANSPLANT OF—									
	<i>Bacillus O</i> .	<i>B. coli</i> .	<i>B. paracolon</i> .	<i>B. typhosus</i> .	<i>B. enteritidis</i> .	<i>B. var. "Hatton"</i> .	<i>B. cholerae suis</i> .	<i>B. icteroides</i> .	<i>B. morib. bovis</i> .	<i>B. typhi mur.</i>
<i>Bacillus O</i> .....	No growth	Good growth	No growth	Good Growth	No growth	Faint	Faint	No growth	Faint	Faint
<i>B. coli</i> .....	No growth	No growth	Faint	Faint	No growth	....	....	....	....	....
<i>B. paracolon</i> .....	Good growth	Fair growth	No growth	Faint	No growth	....	....	....	....	....
<i>B. typhosus</i> .....	No growth	Good growth	Fair growth	No growth	Fair growth	....	....	....	....	....
<i>B. enteritidis</i> .....	No growth	....	No growth	....	No growth	....	....	....	No growth	....
<i>B. var. "Hatton"</i> .....	No growth	....	....	....	....	No growth	....	....	No growth	....
<i>B. chol. suis</i> .....	Faint	....	....	....	....	....	No growth	....	....	....
<i>B. icteroides</i> .....	No growth	....	....	....	....	....	....	No growth	....	....
<i>B. morib. bovis</i> .....	No growth	....	....	....	....	....	....	....	No growth	....
<i>B. typhi mur.</i> .....	No growth	....	....	....	....	....	....	....	....	No growth

A mouse was killed in 24 hours by a large subcutaneous inoculation of an 18-hour bouillon culture. The autopsy revealed lesions typical of an acute general septicæmia. A guinea-pig inoculated subcutaneously with a number of organisms sufficient in amount to invariably be fatal in the case of *B. chol. suis*, recovered after a small local area of induration which persisted for a week or two. Rabbits inoculated intravenously with large doses recovered after an acute illness and an occasional local lesion. No intraperitoneal inoculations were made.

Possibly the most interesting feature of the animal experiments lies in the fact that although the serum of an animal which had recovered from an inoculation did not possess any very marked agglutinative properties toward the other bacilli related to that which had been inoculated; nevertheless, a certain protective immunity seemed to have been acquired. For example, a rabbit which had recovered from several infections with *Bac. O* and whose serum agglutinated this organism in 1-5000 dilution, recovered after an intravenous inoculation with a large dose of *B. chol. suis*, which was fatal to a control rabbit in a few hours. When killed 25 days later the former animal was found to have typical hog-cholera

lesions in the liver and elsewhere. Animals killed by infections with *B. enteritidis* had similar lesions in the liver, gall-bladder, duodenum, etc., and in fact the liver necroses do not seem to be characteristic of any one of these varieties, but merely to represent focal destructions of liver substance by accumulations of organisms present in too great abundance for elimination. There can likewise be seen in all cases lesions of the gall-bladder, with clumped organisms in the bile, which shows the usual changes seen in enteric diseases, of the gall-ducts and of the duodenum which is usually deeply injected and from which the organisms of infection may usually be isolated.

One observation of especial interest was the occurrence in the liver of a rabbit which had rapidly succumbed to an overwhelming dose of *B. cholerae suis*, of extensive fatty degeneration of the liver-cells resembling very closely the condition which is seen in the liver of human beings who have died from yellow fever. It is unusual to find this change in the livers of animals experimentally inoculated with *B. icteroides*, and this has been used as an argument against the possibility that Sanarelli's bacillus could be the cause of yellow fever and its characteristic hepatic degeneration.

## RESULTS OF EXPERIMENTAL INOCULATIONS.

WHITE RABBIT I. Weight 1600 gms. Serum does not react to any member of the intermediate group.

July 13th, 1899. Inoculation in posterior ear vein with one cc. of a 24-hour bouillon culture of *Bac. O*.

July 15th. Ear greatly swollen. Animal quite ill. Refuses food. Temp. 106°.

July 16th. Temperature 104°. Much better.

July 17th. Apparently well. Lively. Eating.

July 20th. Blood taken for serum reaction. Thrombus in ear vein at seat of inoculation. Cultures from thrombus show subsequently several colonies of *Bac. O*. Serum agglutinates *Bac. O* in 1-700 dilution. Reaction complete in 30 mins. No reaction in dilution of 1-50 with *B. enteritidis*, *B. moribificans boris* or *B. "Hatton."*

July 22nd. Reinoculated in other posterior ear vein with two cc. of 24-hour culture of *Bac. O*. Animal remained quite ill for several days. Recovered.

July 28th. Apparently well. Blood-culture negative. Serum reaction positive in 1-4800 dilution. Comparative serum reactions with other bacilli; *B. chol. suis* 1-200, fair reaction. *B. enteritidis* (Gärtner et al.) 1-10, negative.

The slight agglutinative reaction toward *B. chol. suis* suggested that the animal had acquired some resistance against hog cholera and a large fatal dose was given to this animal and to a control animal with the following results:

## WHITE RABBIT I.

August 8, 1899. Intravenous inoc. of 1 cc. of 24 hour bouillon culture of *B. chol. suis*.

Aug. 10. Rabbit well.

Aug. 20. Blood taken for serum reactions shows a reaction toward *Bac. O* and *B. chol. suis* in 1-5000 dilution.

CONTROL ANIMAL, of same weight with negative serum reactions.

Aug. 8. Corresponding inoculation.

Aug. 9. Found dead (18 hours.)

Autopsy. General septicæmia. No mac. changes except injection of duodenal mucosa and an acute cholecystitis with bile thin and pale. Stained preparations from all organs, urine and bile showed a multitude of bacilli.

Cultures. Heart-blood, liver, gall-bladder, peritoneal cavity, and kidneys, *B. chol. suis* pure; urine, *B. chol. suis* and *B. coli communis*.

Organs. Acute fatty degeneration of the liver.

August 28th. Comparative serum reactions of WHITE RABBIT I \* with uninoculated organisms of the intermediate group as well as with *B. typhosus* showed that a slight tendency to agglutination more marked than before the last inoculation had been acquired. The reactions were as follows:

\* Agglutinations were also positive with this serum, having a high reaction toward *B. chol. suis*, toward three individual cultures of *B. ieteroides* (Sanarelli), sent by Dr. Reed from the Washington laboratory as follows:

Organism.	Dilution.	Reaction.
Bacillus O.	up to 1-5000	Positive.
Bac. chol. suis.	" " 1-5000	"
B. ieteroides	" " 1-100	"
B. typhosus	" " 1-200	"
B. enteritidis (Gärt.)	" " 1-50	"
B. var. " Hatton "	" " 1-10	"
B. morb. bovis	" " 1-10	Negative.
B. typh. mur.	" " 1-10	"
B. paracolon (Gwyn)	" " 1-10	"
B. coli com.	" " 1-10	"

1. Orig. culture from Roux's laboratory. Serum reaction positive up to 1-200, suggestive to 1-1000 in 2 hours.

2. B. ieteroides from Santiago case, 1898. Serum reaction positive to 1-50; suggestive to 1-200 in 2 hours.

3. B. ieteroides from Havana case, 1899. Serum reaction positive to 1-200; suggestive to 1-1000 in 2 hours.

Believing from these results that the animal had acquired in some degree a protective reaction toward other members of the intermediate group, although the clumping reaction was not marked in high dilutions, it was then inoculated with a fatal dose of *B. enteritidis* (Gärtner), as was also a normal control animal and another rabbit which had been immunized to *B. typhosus*.

## INOCULATION WITH BAC. ENTERITIDIS (GÄRTNER).

WHITE RABBIT I. Serum reactions given above (Aug. 28).

Aug. 30. Inoc. in post. ear vein with 1 cc. of a 24-hour bouillon culture of *B. enteritidis* (Gärtner).

Aug. 31. Ill.

Sept. 1. Animal killed. Immediate autopsy. Caseous tubercle of ear at site of original *Bac. O* inoculation. (July 13.)

Abdomen. All organs apparently normal except liver and biliary apparatus. Section of former showed small focal necroses. Gall-bladder normal in appearance but containing bile which was thin and pale and which had a yellow precipitate showing through the thin bladder walls. This consisted of desquamated cells and amorphous precip. of bile pigments. No organisms identified. Duodenal mucosa showed several minute hemorrhages in upper 5 cm. Duodenal papilla was erect and injected.

Cultures. Tubercle of ear, heart-blood, kidney and liver, sterile. From the gall-bladder an "intermediate" bacillus was isolated which could not be identified culturally. Identified by serum reaction, however, and shown to be *Bac. enteritidis* (Gärtner), as serum taken from rabbit with pure Gärtner infection clumped the organism in 1-500 dilution and had little effect on hog cholera and *Bac. O*.

Duodenum. An unidentified intermediate bacillus was isolated, presumably *B. Gärtner*, in pure culture.

Sections of the liver showed areas of focal necrosis involving whole lobules.

## BLACK RABBIT—normal control.

Serum reactions negative in 1-10 dilutions to *Bac. O*, *B. chol. suis*, *B. enteritidis* and *B. typh.*

Aug. 30. Corresponding inoculation. (Cf. WHITE RABBIT I, Aug. 30.)

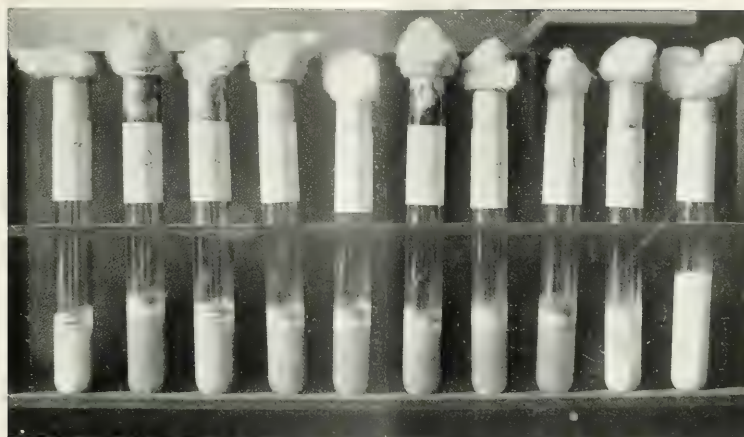
Aug. 31. Very ill.

Sept. 1. Found dead.

Autopsy. No decomposition.

Abdomen. Stomach full of food. Urinary bladder distended. No macroscopical changes apparent except in the biliary apparatus and duodenum. The gall-bladder was distended and injected; full of hemorrhagic bile containing a flocculent precipitate.





1. *B. typh.*      3. *B. paracolon* (Gwyn.)      5. *B. var.* "Hatton."      7. *B. icteroides.*      9. *B. coli.*  
 2. *Bac. O.*      4. *B. enterit.* (Gärt.)      6. *B. chol. suis.*      8. *B. morb. bov.* (Bas.)      10. Control.

FIG. 1 a.—Photograph of reactions in plain milk after 4 weeks. The diminution in opacity of the intermediate forms is well shown. *Paracolon* (Gwyn.) producing alkali more slowly than the others, has not yet reached 4.0 per cent necessary for complete solution of the casein. *B. chol. suis* and *B. icteroides* have been shaken up and show the temporary settling of the surface layer of liberated fat-globules.

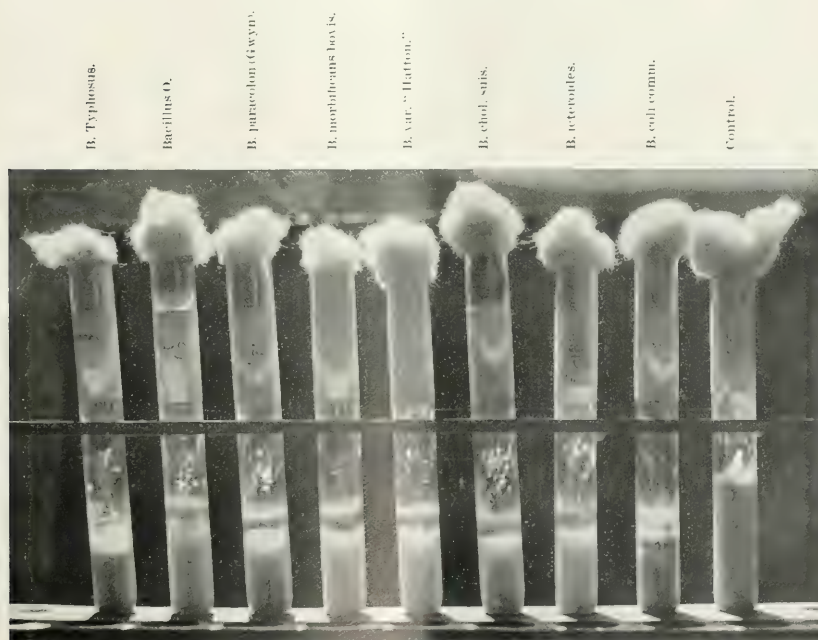
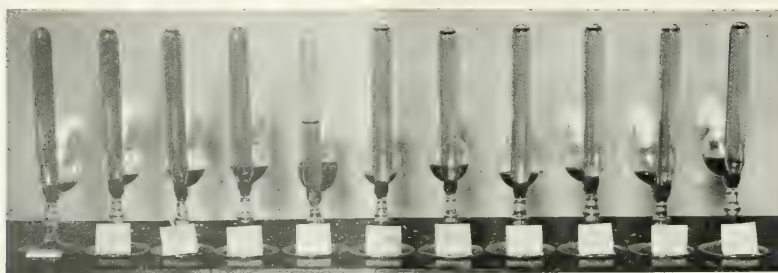
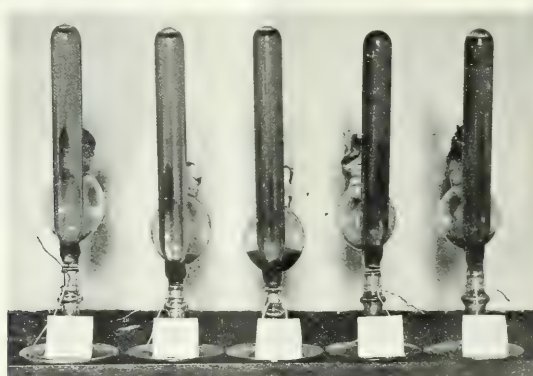


FIG. 1 b).—Photograph taken with transmitted light of the same tubes as Fig. 1 a), showing the comparative translucency of the intermediate group.



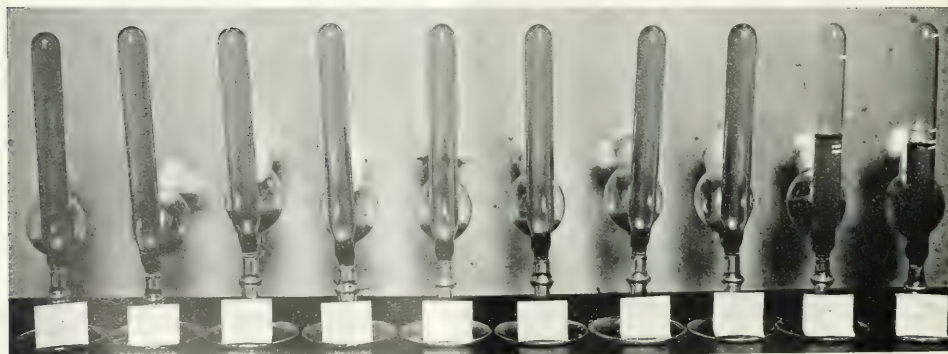
Control. *B. paracolon.* *B. con. coman.* *B. ent. Gart.* *B. chol. suis.* *B. typhi mur.*  
*Bac. O.* *B. typhosus.* *B. morb. bovis.* *B. var. "Hatton."* *B. icteroides.*

FIG. 1.—Reactions in sugar free bouillon, containing 1 per cent of commercial lactose. Gas-production slight in intermediate group due to dextrose adulteration.



*B. morbif. bovis.* *B. enteritidis.* *B. chol. suis.* *B. paracolon.* *B. icteroides.*

FIG. 2.—Reactions in the 1 per cent lactose bouillon not completely freed during its preparation from dextrose. Slight gas-production except with *B. paracolon.*



*Bacillus O.* *B. paracolon.* *B. con. coman.* *B. var. "Hatton."* *B. icteroides.* *B. coli a.*  
*B. typhosus.* *B. enteritidis.* *B. chol. suis.* *B. typhi mur.* *B. coli b.*

FIG. 3.—Typical reactions in 1 per cent lactose bouillon.



Bac. O.                      B. enterit. "Gart."                      B. chol. suis.                      B. typhi mur.  
 B. paracolon "Gwyn."                      B. var. "Hatton."                      B. icteroides.

FIG. 5.—Gas-production in sugar-free bouillon containing 1 per cent of dextrose.

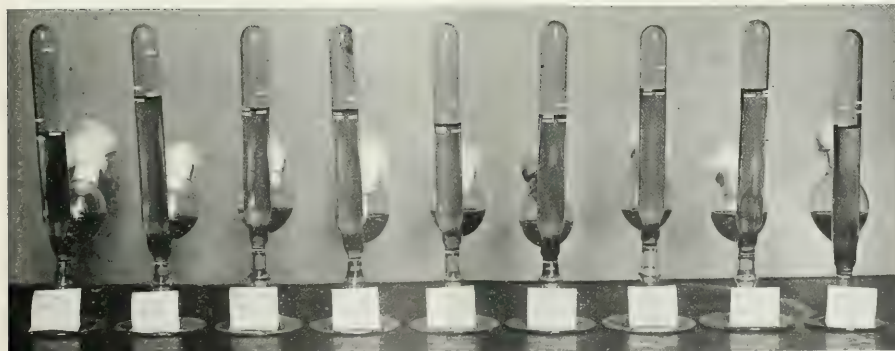


FIG. 6.—Gas production in sugar-free bouillon containing 1 per cent of dextrose. For comparison with Fig 5. Showing relative slowness of gas-production with Bac. O and Gwyn's paracolon. The daily production of gas is indicated by labels.

FERMENTATION REACTIONS IN DEXTROSE BOUILLON.



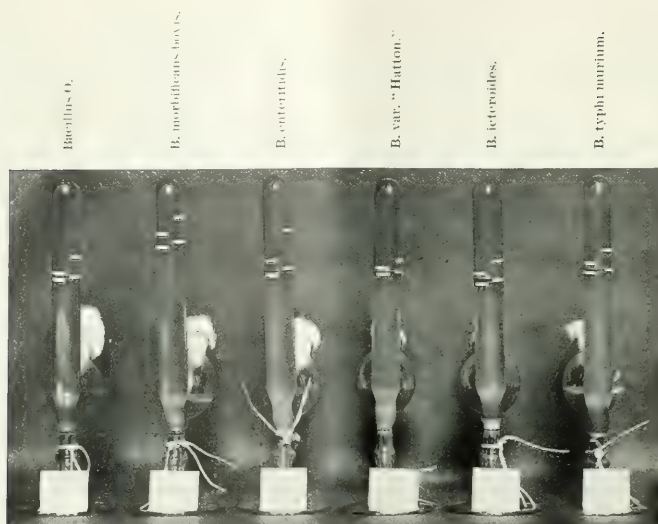
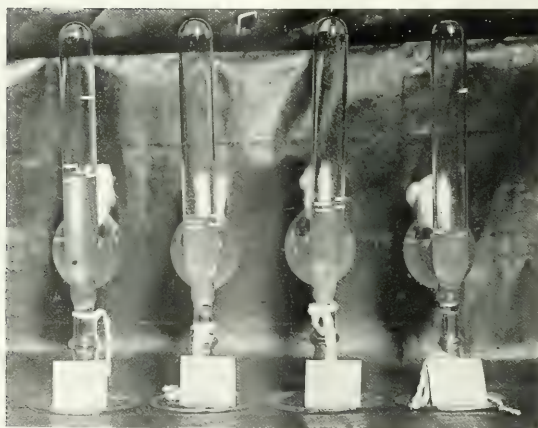


FIG. 7.—Reactions in sugar free bouillon containing 1 per cent mannite.

FIG. 8.—Reactions with 1 per cent mannite. Showing usual proportion of gas and sediment produced by *Bacillus O.* The production of gas in the first twenty-four hours is much less than with the others unlike Fig. 7.

## FERMENTATION REACTIONS IN MANNITE BOUILLON.



FIG. 9.—Reactions in sugar free bouillon containing 1 per cent saccharose.

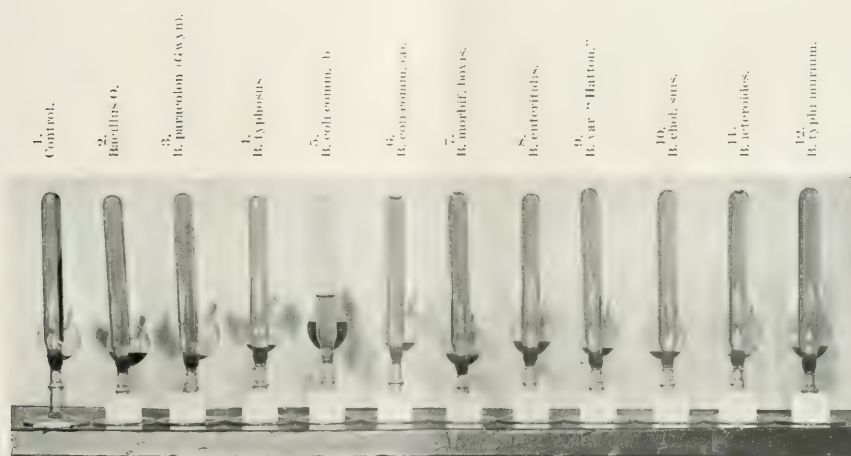


FIG. 10.—Reactions in 1 per cent litmus saccharose which had been partially converted during sterilization. Slight production of gas in tubes 2, 3, 6, 7, 9, 11, after 18 hours of incubation. At this time the litmus is completely reduced in the closed arm of the tubes containing the more rapidly growing organisms, 7, 8, 9, 10, 11, 12. Reductions of litmus in 2 and 3, slower in growth, are not complete till five days. The photograph shows the darker color of these tubes which have varied but little from the control.

FERMENTATION REACTIONS IN SACCHAROSE BOUILLON.





The mucous membrane of the duodenum in its upper 8 cm. was deeply congested, showing punctate hemorrhages, and the whole bowel and serosa over it were edematous. The duodenal papilla was swollen and prominent and had two bright punctate points of hemorrhage on it.

Stained preparations of all the organs, bile and urine showed myriads of bacilli.

Cultures showed a pure septicæmia as follows: Heart-blood, spleen, kidney, liver, and gall-bladder, *B. ent.* (Gärtner), pure culture; duodenum and urine, *B. ent.* (Gärtner), and *B. coli com.* and an unidentified bacillus.

Sections of liver showed hepatic cells greatly swollen and having undergone a fatty change. No focal necroses.

BLACK AND WHITE RABBIT. Same weight.

Previously immunized to *B. typhosus*.

Preliminary serum reactions.

*B. typh.* 1-2000 positive.

*B. ent.* 1-10 positive and suggestive to 1-100.

Aug. 30. Corresponding inoculation. (Cf. WHITE RABBIT I, Aug. 30.)

Aug. 31. Lively.

Sept. 5. Died 3 P. M. Immediate autopsy. Blood taken just before death shows an agglutinative reac. toward *B. ent.* of 1-500.

*Macroscop. lesions.* Liver pale, soft, showing small yellowish areas of apparent necrosis.

Gall-bladder greatly distended, thin-walled and transparent. Bile, thin and watery with an abundant mucoid yellow precip. showing through the walls. Stained preparations from this fluid show masses of bacteria, chiefly in clumps, and desquamated goblet cells. No motile bacilli seen on hanging drop.

*Duodenum* negative. A few slightly injected points. Other organs were mac. negative.

*Cultures.* Heart-blood, sterile; spleen, few colonies of *B. Gärtner*; kidney, sterile; liver, few colonies of *B. Gärtner*; gall-bladder, multitude of colonies of *B. typhosus*, an unidentified Bac. and *B. Gärt.* (?).

*Duodenum.* *B. pyocyaneus*, *B. coli com.*, unidentified bac. peptonizing milk.

Sections of liver show large areas of focal necrosis similar to those seen in WHITE RABBIT I.

From these last experiments we see that the normal control rabbit died of an acute general infection from *Bac. Enteritidis* with the usual characteristic lesions, especially referable to the eliminative system, namely, of the liver, gall-bladder and duodenum, from which organisms were obtained in greatest numbers. The rabbit (WHITE RABBIT I), which had apparently recovered from its infections with *Bacillus O* and *B. cholerae suis*, was killed at the same time, and it was found that no bacteria remained or could be found in the general circulation or organs, but an organism persisted in the gall-bladder which could be identified by serum reactions alone and was shown to be that of the most recent infection, namely, *B. enteritidis*.

The "typhoid" rabbit succumbed to his infection in six days with the characteristic lesions found after fatal inoculations with *B. chol. suis*, *B. icteroides* or other members of the group which are actively pathogenic. Necroses of the liver similar to those seen in this animal were found in WHITE RABBIT I when killed, and were probably due to the hog cholera rather than to the more recent Gärtner infection else the control rabbit would have exhibited them.

These observations are too few in number to lead to any broad conclusions. They, nevertheless, are very suggestive of the possibility that immunization with one of these forms endows the animal with a certain degree of resistance toward infection with the others. Furthermore, an acquired serum reaction toward one form does not furnish agglutinative properties of equal degree toward other varieties even though they are so closely related as to be culturally indistinguishable. Thus agglutinative sera for individual forms may be obtained, by which means alone we can differentiate the organisms.

#### IN REVIEW.

A consideration of the cultural properties of the organism, *Bacillus O*, which has been dwelt upon at such length, demonstrates its close relationship to the definite and hardly recognized group of bacilli of the hog cholera or *B. enteritidis* of Gärtner type, which bacilli, having some characteristics peculiar to both the typhoid and colon groups, may be said to occupy a biological position intermediate to them. Whether the cultural characteristics of these organisms are but temporarily acquired, and whether they should merely be regarded as having a transient intermediary existence, may be a question of dispute; but, nevertheless, a certain distinct isolability for these particular forms is demonstrable, and the definiteness of the serum reactions, pathogenicity, and perpetuation of cultural features justifies their installment in a separate group.\*

The elaborate tables of Germano and Maurea,<sup>20</sup> of Tavel and Lanz, of Gilbert, Booker, Smith and others show what a variety of closely related bacillary forms of this family may be isolated from one source or another. In a recent study of the intestinal flora of dogs, Dr. Livingood and the writer † isolated about fifteen varieties of bacilli, chiefly of the colon and paracolon type, though several more intermediate forms were found, and on not a few occasions organisms indistinguishable from *B. typhosus*. It can thus be readily understood, if typical or allied forms of these various groups occupy at one time or another the alimentary tract, that during the course of fevers associated with intestinal lesions they may easily find their way into the portal circulation and cause an infection superimposed on that of the original disease. It has been shown, however, that colon, which is a permanent inhabitant of the lower intestine where these lesions are usually situated and consequently the most frequent secondary invader, is rarely found in infections beyond the confines of

\* Cf. Flexner, Simon. Microorganisms. Twentieth Century Practice of Medicine, Vol. XVIII, p. 655, 1900.

<sup>20</sup> Germano and Maurea: Vergleichende Untersuchungen über Typhusbacillen und ähnliche Bakterien. Ziegler's Beiträge, Bd. XII, S. 495, 1893.

† Experimental and Surgical Notes upon the Bacteriology of the Upper Portion of the Intestinal Canal, etc. Contributions to the Science of Medicine, dedicated by his pupils to William H. Welch, p. 571, 1900.

the abdominal cavity. Gwyn's *paracol* and *Bacillus O*, on the contrary, were isolated, one from the peripheral circulation and the other from a surface lesion, and consequently it is unlikely that they were secondary invaders. Furthermore, the patient's blood reacted strongly to these organisms and not to *B. typhosus*, and it is not improbable that they were the specific cause of the disease, which resembled clinically typhoid fever. For similar reasons the recovery of *B. icteroides* from the peripheral circulation of patients suffering with yellow fever would favor Sanarelli's view that it is the cause of a specific fever and not a secondary invader, as many are inclined to believe.

The individuals of this group of organisms spoken of as an intermediate group present a wide range of pathogenic activity toward man and animals, and though they can be distinguished by their response toward various specific sera, they are practically identical in their cultural reactions. Their chief distinguishing features from *B. coli* and *B. typhosus* may be given as follows:

*Chief distinguishing features of the Eberth or typhoid, Gärtner or intermediate and Escherich or colon groups.*

*B. typhosus.* An actively motile bacillus possessing as many as 14 flagella at times and having marked pathogenicity toward man though slight toward the lower animals. Reaction in milk is acid, with a very late (months) or no terminal alkalinity. The organism ferments glucose but not lactose and produces no gas from any carbohydrate medium. Under ordinary conditions of isolation there is no production of indol.

Fermentation reactions:

	Dextrose.	Lactose.	Saccharose.
Total gas	0	0	0
Aerobic:	Acid	Alkaline	Alkaline
Reactions:			
Anaërobic:	Acid	Neutral	Neutral

*Intermediate Group. B. Gärtner and B. chol. suis* type. Bacilli with the morphology of *B. typhosus* and possessing an equal or greater number of flagellæ. Actively motile and in many cases having a distinct pathogenicity for both man and animals. Reaction in milk presents an early and terminal strong alkalinity in the presence of air, appearing after a transient acidity. Milk is never coagulated. They ferment glucose, with the production of gas, never lactose or saccharose. Under ordinary cultural conditions no indol is produced.

Fermentation reactions:

	Dextrose.	Lactose.	Saccharose.
Total gas	1/2	0	0 or bubbles
H/CO <sub>2</sub>	2/1	0	0
Aerobic:	Acid	Alkaline	Alkaline
Reactions:			
Anaërobic:	Acid	Neutral	Neutral

*Bacillus O* and *B. paracol* (Gwyn) may represent a subdivision of this group, being slower in their action on milk and growing less luxuriantly and more like *B. typhosus* in various fluid media and resembling it in their pathogenic action on animals.

*B. coli* and its many allied forms. A bacillus with sluggish motility possessing few flagellæ. Pathogenicity ordinarily is slight for man and animals. Growth on potato is abundant and colored. No alkalization in aerobic growth. Reaction in milk is acid, invariably sufficient for coagulation. It ordinarily produces a large amount of indol. It ferments glucose and lactose. Saccharose may or may not be acted upon.

Fermentation reactions:

	Dextrose.	Lactose.	Saccharose,	
			var. (a)	var. (b)
Total gas	1/2	1/2	0	2/3 slow
H/CO <sub>2</sub>	2/1	2/1	0	3/2
Aerobic:	Acid	Acid	Alkaline	Acid
Reactions:				
Anaërobic:	Acid	Acid	Alkaline	Acid

## CHARLES FREDERICK WIESENTHAL, MEDICINÆ PRACTICUS, THE FATHER OF THE MEDICAL PROFESSION OF BALTIMORE.\*

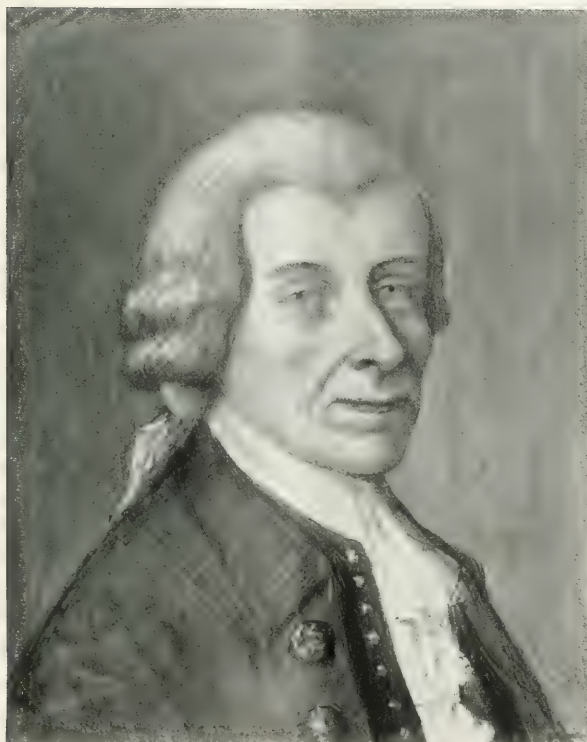
By EUGENE F. CORDELL, M. D.

The first name of any importance in the medical history of Baltimore is that of Charles Frederick Wiesenthal, who was born in Prussia in 1726 and who settled in Baltimore in 1755. Family tradition asserts that he was "physician to Frederick the Great," but we possess no further details of his life in his native land. His familiarity with the organization of the medical department of the Prussian army, shown in his letters to the Maryland authorities during our Revolutionary War, lends some plausibility to the supposition that he may

have been connected with that service during his early professional life. There is evidence to show that his family enjoyed a good social position, and his educational advantages must have been considerable.

It is uncertain whether he possessed a medical degree or not. Dr. Ezekiel John Dorsey, a pupil, in dedicating a thesis to him (Edinb., 1776) adds M. D. to his name, while another pupil, Dr. George Buchanan, in a similar dedication (Phila., 1789) gives the name only without title. He does not appear ever to have used the degree himself, and in the account of the establishment of the first Lutheran church in

\* Read before the Johns Hopkins Historical Club, Feb. 12, 1900.



CHARLES F. WIESENTHAL.

REPRODUCED FROM A PENCIL SKETCH BY HIS SON ANDREW.





Baltimore, drawn up it is believed by himself, he is referred to as "Karl Fried. Wiesenthal, *Medicinæ Practicus*." He makes no allusion to the subject in any of his letters, not even in that urging upon Andrew the importance of a degree.

There were not many inducements for an aspiring young physician in "Baltimore Town," when Dr. Wiesenthal settled here at the age of 29. It was then but a small village of some hundreds of inhabitants, with unpaved streets, with but one church and without a newspaper. Its chief thoroughfare, "Long," now Baltimore, St., was in a wretched condition—indeed at times impassable. Within five years certainly it had been enclosed by a picket fence and gates to protect it from Indians. Annapolis, on the other hand (where Upton Scott had settled two years before) was the seat of government, the centre of the fashion, influence and culture of the Province. But Baltimore, under the guiding genius of her "Romulus," as he was called—Dr. John Stevenson, a north Irishman—was even then looming up as the commercial metropolis of the state and it may be that he foresaw the future greatness which awaited it. Or he may have emigrated with a party of his countrymen, who selected Baltimore for a home, and from whom he was unwilling to be separated. Furthermore the country around was well settled and many of the landed proprietors were men of means, and able to compensate a physician liberally for his services.\*

The summer that he arrived was signalized by the defeat of Braddock's army, an event that favored the growth of the town by deterring settlers from going westward. Shortly after his coming he married a lady of York, Pa., who bore him one son and three daughters. In 1771, he became naturalized. During the Revolution, he warmly espoused the cause of the patriots and his services and advice were of the greatest value to the state and country. In January, 1775, he was made a member of the Committee of Observation of Baltimore County and in December of the same year he received the appointment of superintendent of the manufacture of saltpetre for the state. In one of his letters he describes a journey made to some caves on the south branch of the Potomac, where an abundant supply of saltpetre was found. He published his method of manufacture of this substance in the Maryland Gazette, January 2d, 1776. On March 2d, 1776,† he was commissioned by the Council as Surgeon-Major of the 1st Maryland Battalion commanded by Col. Smallwood. In a letter to the Council of Safety, written at this time and still extant, he expresses his willingness to assist the cause to the extent of his power, strength and abilities and to go with the troops wherever they should be ordered. On the 12th of March, 1776, he published an appeal to the public

"for linen rags & old sheeting for bandages." In the same year he was Medical Purveyor for the Maryland troops and Examiner of candidates for medical positions in the Service. In 1777, according to Quinan he was Surgeon-General of the Maryland troops, in which position he received a salary of "35 shillings a day & no rations." Dr. Wiesenthal does not appear to have served with the troops in the field, although he visited them in an official capacity in their camps. He seems to have had the general supervision of medical affairs in Baltimore, establishing and conducting a hospital, purchasing medical stores and instruments, examining candidates and rendering professional services to the soldiers and sailors in the service of the state at this point.

According to Mrs. M. E. Reigart, of Baltimore, his granddaughter (who is here present this evening), Dr. Wiesenthal resided first in the suburbs of the town in a stone house on the Clifton Road, which is still standing. At what time he moved to his Gay Street house does not appear, but there he lived for many years, occupying two adjoining 2½ story dwellings, the one to the north as a dwelling house, and the other as an office.\* These houses were demolished about 25 years ago and a large shoe store was built on their site. The lot extended through from Gay to Frederick Street, and on the rear of it Dr. Wiesenthal erected buildings for his medical school and dissecting room. In these, which are still standing, he taught many students, among whom were Drs. William Augustus Dashiell, George Buchanan, Ezekiel John Dorsey, Andrew Wiesenthal and Frederick Dalcho.† In one of

\* Southeast corner of Gay and Fayette Streets, now Hill's Shoe Store. Fayette Street was not opened east of Gay until about 50 years ago, so that there was no corner there in Dr. Wiesenthal's day.

† Frederick Dalcho was born in London in 1770, his mother being Elizabeth Wiesenthal, a sister of Dr. C. F. Wiesenthal, and his father a distinguished officer under Frederick the Great, who having been severely wounded in battle had been permitted to retire to England for his health. Upon the death of his father, at the invitation of his uncle, young Dalcho came to Baltimore to prepare for the profession of medicine. He arrived in Baltimore in a sailing vessel on the 23d of May, 1787, "after a boisterous passage of 8 weeks." Here he obtained a good classical education, after which he devoted himself successfully to medical study including an extensive course of botany. He is said to have taken the degree of M. D. (his name is not included in the Catalogue of graduates of the University of Penna., but that catalogue is known to be very defective), and then to have obtained a commission in the medical department of the U. S. A. While stationed at Charleston, S. C., some difficulty arose between him and his fellow officers and he resigned (1799). He then entered on practice in Charleston and assisted in the establishment of a Botanic Garden. In 1807 he became coeditor of the Charleston Courier. He was also a very influential member of the Masonic body and later their Grand Chaplain. By request he published a work upon masonry which was adopted by the Order as an authority. In 1811 he became much interested in theology and a lay reader in the Episcopal Church. He was ordained Deacon in 1814 and Priest in 1818. In 1819 he was elected assistant minister of St. Michael's Church, Charleston, and continued with fidelity and acceptance to discharge the

\* Gov. Sharpe reports, May 2, 1754, that the town has the appearance of the most prosperous one in the Province. Few, he says, except Germans, who are commonly the possessors of small sums of money, have settled and built in it. Letter quoted in *Trans. German Hist. Soc. of Md., 4th Ann. Report*.

† Quinan's Annals.

his letters (June 5, 1787) he speaks of the dissection of a little negro boy which young Daleho was at that moment engaged in making. It must have been here, too, that the body of the murderer Cassidy was being dissected in 1788 when the mob collected and put a forcible end to the procedure.\*

Dr. Wiesenthal was a zealous Christian and it was largely through his efforts and liberality that the first Lutheran church was built in Baltimore.† He was also President and Physician to the German Society (1784).‡

Dr. Wiesenthal was not only a public-spirited and useful citizen, but he was also a learned and skilful physician; devoted to his profession and ever seeking to promote its highest interests. His letters to his son Andrew, who studied first in Philadelphia (1781-2) and later in London (1786-9), designed for his son's eye alone, display the purity of his character and the loftiness of his motives. They contain also many interesting items, advice and allusions upon which I shall proceed to draw in further illustration of my subject.§ In the first of the series dated Dec. 25, 1781, he says: "We received your Letters . . . in which I see your beginning to dissect yourself which pleases me and I insist that you continue to do the same manually in *propria persona*, and not being content with merely demonstrations after the Subject is prepared, as

duties of that position until declining health compelled him to seek repose. His vestry declined his offer of resignation but gave him an indefinite leave of absence with continuance of his salary. He died Nov., 24, 1836, aged 76. His principal work was a history of the P. E. Church in S. C. during the colonial period, which is considered an authority upon that subject. He wrote other religious works, sermons and essays, and edited a church paper. A monument was erected over his grave by the vestry of the church. He was about 5½ feet high and well proportioned. His manners were genial, his intellect vigorous and well cultivated and he was a general favorite in the community. See *Annals of American Episcopal Pulpit*. By Wm. B. Sprague, N. Y. 1859.

\* Griffith's Annals.

† This church stood on the south side of "Fish" (Saratoga) St., near "Bridge" (Gay) St., and near the site of the present Bethel African M. E. Church. The first building was erected in 1762 and was an unpretentious wooden structure used also as a schoolhouse. It stood on a high and steep hill. About 1771 the excavations for streets in the vicinity, made the building insecure and shortly after it was pulled down, the material sold and the hill leveled. A brick building was erected on the same site (Quinan says in 1773). "After twelve years," to provide further accommodations for the growing congregation, an addition was made to it. The late Rev. Dr. H. Scheib recollected this ugly structure with its organ. It was entered by a high stairway at the side. In 1808 it was sold to the African church and a large church was built on ground further to the north, the present Zion Independent Lutheran Church. Dr. W. was a liberal contributor to the early church; he was an elder of the congregation and his name comes always at the head of the lists of members. See *The Zion Church of the City of Baltimore*, by Rev. H. Scheib, 2d Ann. Rept. Germ. Hist. Soc. of Md.

‡ Quinan, *op. cit.*

§ They are closely written in a fine, neat hand. They are less closely copied in the extracts here given.

I want the practical part. it will lead you towards Operations and will make that part of Surgery more intelligible. I hope you will not be content with merely knowing the Situation of the Viscera, but will examine them minutely, their contents Vessels Ducts &c." . . . "I hear Doctor Shippen has a young Gentleman who prepares the Subjects for his Demonstration I would have you cultivate a strict friendship as far as his Morals will admit of (in which particular you know my firm Opinion) and frequently make Inquiries of the Doctor himself, who I hope is often with you himself & teaches."

In Dec., 1787, he expresses his satisfaction at Andrew's predilection for surgery, "in which the Quack must stand aside, whereas in Physic in this part of the World the most errant Quack if he has Assurance enough will often claim the preference & obtain it before the Man of real and true Abilities."

Here, from the first letter, is an allusion to Dr. Thomas Bond, of Philadelphia, the founder of the Pennsylvania Hospital and the first clinical lecturer in America: "I am glad you have introduced yourself to Doctor Bond though he may have some Oddities, you may nevertheless rely on this that his Acquaintance will be valuable to you both his Learning and Experience are unquestionable, and he moreover is very communicative and takes a Delight in instructing young Persons and that in proportion to their Diligence and Application you will therefore visit his Lectures frequently and freely • apply to him to resolve Such things as may be obscure to you, he is a good Surgeon besides and may give you Some good hints in the hospital."

There are but few allusions to cases and operations. "Mr. Yates . . . was formerly to become a Surgeon but has quitted it . . . but although he quitted Surgery that did not quit him, he having a fistula in Ano and undergoing an operation in London unsuccessful he came over to Maryland and recommended to me by Governor Smallwood. I laid it open very extensively, and found it proceeding near the root of the penis up to that region between the bladder and the Rectum as well as along the Anus and to the Ischium where I was even apprehensive of a Caries, he having once had a Caries on the Tibia and lost a large Exfoliation, it moreover enters the Rectum as he says he has found some Excrements pass through the Wound and frequently flatus." . . . "I had last Summer a Child 4 Months old of Mr Willm Buchanan's under my Care whose head bulged out and distended every Suture it was taken with Convulsions. it was cured by applying blisters to the Spots for Some Weeks." He sends the report of a case in which "the quantity of matter issuing from a tumor no bigger than a walnut was nearly 3 pints." In Sept., 1788, he writes: "Mr Wolsenhome from St Mary's City was this Morning with me for my Advice he came but lately from London has formerly had my Opinion in writing concerning some nervous Symptoms deriv'd from the Gout. he has consulted several eminent Physicians in London especially Dr Letsome & Heberden. he show'd this Letter I mean Heberden, my Opinion in writing concerning the Complaint &



Treatment which being approv'd of by the Doctor furnished some little Stoff for my Vanity." In an earlier letter to the Council of Safety (*Md. Archives*, Dec. 8, 1776) to which my attention has been called by Dr. Jackson Piper, he describes a curious case of "Erysypelas" in a soldier, due to taking cold, and involving the entire body "from head to foot." "the Vesications common in that Disorder displaying a humour so sharp that in a few days he was all over depriv'd of his skin." He had likewise lost his eyesight and his life had been saved with the utmost difficulty. The doctor regarded the blindness as incurable. He advises Andrew to study to become skilful in surgical operations especially lithotomy and "extraction" of cataract. He refers to the great success of Dr. Tyler, a young physician of Frederick who had made considerable reputation in "couching the cataract." He tells him to study closely the action of drugs and to make himself acquainted with all new discoveries.

He was very anxious for Andrew to take a degree and expresses regret that the latter had not gone to Edinburgh to study instead of to London. He longs to see something in print "over the name of A. Wiesenenthal that may meet the approbation of the learned." He asks what is to be the theme of his inaugural essay? in what language shall it appear? Is he sufficiently master of the Latin to hold a public disputation? In Leyden, at least, a public disputation is not demanded—perhaps at Rheims the same is the case. Would that he were with him to assist with advice and counsel! He sends A. from time to time copious notes of cases and opinions on various medical subjects, which he urges him to put into shape for a thesis or for publication in some journal. Oct. 14, 1787, he writes: "I have sent you various Cases in Physic and will consider of some more, and I think I will likewise send you some of my Theoretical Opinions which you may be probably able to elaborate something farther and should it be worth the Notice of some of your friends it might be perhaps worth while to have it published, for this is Truth that a great many more silly things have been published than what we should." In Nov., 1788, he tells him that a diploma is indispensable and suggests that he might obtain one in some institution without residence, or an honorary one. "Doct. Brown the great opposer to Dr Cullen's Doctrine and who now resides in London and as common Report says even in the Fleet's prison where he lectures, has wrote many a young Students Thesis on which he obtained his Diploma blindfold."

The substantial of life are not forgotten. The Christmas letter of 1781 already spoken of concludes: "We congratulate you to these Christmas holidays and wish you had one of our very good min'cd pyes." In Oct., 1787, he sends Andrew a box of "hommany Beans & Sweetmeats." In another letter: "Mr. Yates sails on the Willing Tom next Week and I hope he will be able to take the Geese with him but I am allmost afraid we are too late. Mama I apprehend by wanting to extend her bounties will be the Cause of your getting none." The next day—in a postscript—"My Suggest-

tions are but too true, the Willing Tom is sailing from Patowmack and the smoaking the Geese requiring a little more [time] lay till at last the S(c)hooner saild from Annapolis by which all remaining Stores were sent and Mr Yates going by Land obligd us to postpone it to another Opportunity which we hope will soon happen."

Dr. W. was very anxious to have a law passed for the regulation of medical practice in the state and headed a movement with that object in view. The prevalence of quackery, the low standard of medical training and the reprehensible conduct of many physicians in good standing, made an organization of the profession and a regulation a necessity. On Sept. 12, 1788, he writes thus: "To rescue the Dignity of Physic from that horrid State into which it is plunged within these few years and most especially since my Sickness will require a Herculean Labour, and it will fall in some Misure to your Lot to undertake the laborious Task." After a full and public discussion of the matter in the town paper, a meeting was called for Nov. 27, 1788, the call being signed by himself. At this meeting which was most probably held at his house, he was chosen chairman. There is mention of it in a letter dated Nov. 28, 1788: "We are just about procuring a Medical Regulation in a little more earnest than heretofore, it nevertheless meets with some underhand jealousy and what amazes me it comes from Doct. B. . . we have had 3 meetings he has had allway\* written Invitations and each Time evaded it. The reason we only guess at. Last Nights meeting it was proposed for the Sake of Order and to have jointly more Weight to organize ourselves into a Society under Rules. I was unanimously nominated President and Mr Frederick for Clark, so that he has now an office." The plan which was then framed embraced the entire state in its operations and was similar in its features to the Charter of the Medical and Chirurgical Faculty adopted eleven years later. But for Dr. Wiesenenthal's ill-health and death the following spring, there is little doubt that he and his associates would have succeeded in their object, and thus have anticipated by ten years the founding of the Medical and Chirurgical Faculty.

Dr. Wiesenenthal almost idolized his son Andrew—his only son. His letters abound with the most endearing expressions, as this: "so tender a father as I am who makes his Sons welfare his only happiness in this World," and he lavished his money freely in giving him the best opportunities then available for education. In Sept., 1788, he estimates that he has supplied Andrew with nearly £450 sterling—"a pretty Modest Sum in these dreadful Times," he adds. Moreover we must remember that Andrew lived with his aunt during his stay in London, and that the above amount did not include his books, instruments, medicines and the passage money home, which were still to be provided. He chides him mildly on one or two occasions and refers to a letter of A.'s headed "*sans six sous*," which seems to have worried him a great deal.

The following pathetic passage occurs in a letter of No-

vember 28, 1788: "I for my part am already discarded and laid up like an old Man of Warship. although the Shafts of Jalousy are still continued to be let off against me as if they dreaded my returning to my usual Strengt again nay I verily believe, they will hate my very Memory ten Years after my having returned to Dust, and be afraid and Jalous of me (horrid indeed!) if I reflect that at all Times I have acted up to the Dignity of the Profession, have disdained all mean Empyrical Methods, because I had no Occasion I think that I ought to be respected as a father and Supporter of the Profession and be treated friendly." In another letter about the same time he writes: "I find no remedy now in the late Evening of my Life as to prostrate myself before the Throne of the Almighty and expect in the other World that which this has denied me."

Towards the last, Dr. Wiesenenthal, who was of a highly nervous temperament, suffered greatly from hypochondria. Every circumstance became irksome to him and he sought and found relief from his despondency in the tinctura thebaica which he supplemented with the liquor anodynus Hoffmanni. The dose which he took of the former was not extreme, not exceeding, according to his statement, 40 to 45 drops.

His last letters show that he was failing. Sept. 12, 1788, he writes: "My health, my dear son, is very precarious and being in my grand Climacteric, the 63d year of my Age I find myself declining every day." Although he lingered on to the spring of 1789, his eager longing to see his son before he died was not gratified. There is something inexpressibly sad to see this good old father sinking into the grave, hoping day by day for the return of his son beyond the sea and with his life lit up by that one thought alone.

The following is the notice of Dr. Wiesenenthal's death taken from the *Maryland Journal and Baltimore Advertiser* of June 2, 1789: "The shaft he so often warded from others has pierced him at last. Yesterday morning about half past seven o'clock departed this life Dr. Charles Frederick Wiesenenthal, in the 63d year of his age after having practiced in this town for 34 years. If the strictest attention in his profession which humanity could excite & that success which might be expected from superior medical abilities improved in an uncommon measure by reason & observation deserve to be remembered, the tears of gratitude must flow in sorrowful profusion. HE IS GONE! & the pain of reflection is the more heightened because it is at the time when he was in daily expectation of the return of an absent & only son whose virtues & abilities are beloved & admired by all who know him."

Dr. Wiesenenthal's picture suggests a large, fine looking dignified man with a German type of countenance. He was generous and hospitable and particularly kind to the poor,

often remitting his charges against them when they seemed unable to meet them.\* His dress is described as follows: "a scarlet cloak, three cornered hat, blue velvet coat with gold buttons & buff facings, buff vest, lace ruffled shirt, knee breeches, stockings, shoe buckles, plain white cravat surrounding neck, wig & cue tied with a black ribbon." He was the first physician in Baltimore to drive a four-wheeled carriage. On this was inscribed his crest & motto—"a horse's head bridled & bitted with two crossed arrows beneath & the words Premium Virtutis."

Dr. Wiesenenthal's remains were interred in the burial ground attached to the church, but were afterwards removed to Loudon Park Cemetery. No tombstone was ever erected over them. Andrew died in 1798, at the early age of 36, leaving a son Thomas Van Dyke Wiesenenthal, who became a surgeon in the U. S. N. There is only one person now living bearing the name of Wiesenenthal, an aged single lady residing in Boston, but whose present residence we have not been able to find.

One of Dr. Wiesenenthal's pupils in dedicating his graduation thesis to him, speaks of his "great professional skill, his rare & singular virtues & his nobility of character";† another compares his position in Baltimore to that of Sydenham in London.‡ I venture to think that after what we have heard this evening we shall not consider him unworthy of the further title—one which he so much coveted—"Father of the Medical Profession of Baltimore."

[In connection with the above paper, there were shown a pencil portrait, drawn by his son Andrew, his crest and motto, and a photograph of his medical school, still standing.]

Authorities consulted:

Letters of Dr. C. F. Wiesenenthal, MS.

Quinan's Annals.

Maryland Archives.

Newspapers of Baltimore and Annapolis.

Griffith's Annals.

Rev. Dr. H. Scheib's Article (Germ. Histor. Soc. Pubs.).

Family Tradition (Mrs. M. E. Reigart).

\* "When patients came to settle bills, if poor, he would look in his books and say: 'I don't find anything against you.'"—Mrs. Reigart.

† *Dissertatio Inauguralis de Nutritione*. Ezekiel John Dorsey, Edinb., 1776.

‡ *Vir Venerabilis, Carolus Fredericus Wiesenenthal, rei medicæ apud Baltimoreenses cultor felicissimus, qui ob magnam omnium quæ medicinam spectant, notitiam, non minoris ibi quam Sydenhamius olim apud Britannos fuit æstimatus, penditur*. Inaugural Thesis of Dr. George Buchanan. Univ. Pa., 1789.

## THE JOHNS HOPKINS HOSPITAL BULLETIN.

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Dr. Wiesenath's Medical School, the first established in Baltimore. We do not know when it was opened, but there are grounds for conjecturing that it was between 1760 and 1770. In February, 1774, Dr. W. A. Dashiell defends the views of his preceptor C. F. W. in the newspaper, a controversy having arisen between the latter and Dr. Ephraim Howard, concerning the use of venesection in a case of pneumonia, and in his inaugural thesis at the University of Edinburgh, 1776, Dr. E. J. Dorsey speaks of Dr. W. as having taught him the elements of medicine. The view was taken from a second-story window of house northeast corner of Frederick and Fayette streets, and one is looking a little south of west. The street before us is Fayette, between Gay and Frederick. In the distance one sees over the tops of the houses, the cross of Church of the Messiah (P. E.), on Gay street. In the centre of the square is the long two-story schoolhouse containing the sign "Hill's Hand-made Shoes". The smaller two-story building, at the nearer end of the square, also stood in Dr. W.'s day, and is believed to have been his dissecting-room. At the further corner of the square is Hill's shoe-store, built about twenty-five years ago, on the site of Dr. W.'s residence. Fayette street, formerly "East Street," was not opened between Gay and Frederick until about fifty years ago, and the doors and windows of the school-house on that side must have been made at that time. The stone steps at the side used to be at the front entrance. The old lady is Mrs. Reigart, granddaughter, and the young gentleman to her left, at the edge of the pavement, is Mr. John Milton Griffith, great-great-grandson of Dr. W. Mrs. Reigart lives at 216 Girard avenue, and is over 82 years of age. Behind them is the writer of this sketch. After his father's death in 1789, Andrew taught here until his death, in 1798. Shortly after the latter event, the house, which was then 40 N. Gay Street, passed out of the possession of the family. It is now unoccupied. About fifty years ago it was used by Mr. McMullan (who is still living) as a furniture storeroom. Mrs. Reigart is the daughter of Julianna Susanna Beneowsky Wiesenath, "the mischievous little Julianna, the pretty little babbler," of the letters, born four years before Dr. W.'s death and named from her godmother, Countess Beneowsky, sister of Mr. Mesnonnier, the importing merchant of Baltimore, who married Dr. W.'s daughter Elizabeth. To be absolutely certain that there was no mistake, the writer took Mrs. R. (who is a very intelligent person, with senses and faculties all good) to see the premises, which we inspected thoroughly. Although she never lived there, she has perfect recollection of the place, which she has often visited before. She says that her mother's nurse—a white woman—died to an advanced age, and often talked to her of her grandfather and his family, and pointed to the building as her grandfather's school. There is, therefore, no question about its identity.





# I. PRIMARY CARCINOMA OF THE APPENDIX VERMIFORMIS; II. CARCINOMA OF THE APPENDIX SECONDARY TO CARCINOMA OF THE OVARIES.

BY ELIZABETH HURDON, M.D.

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New growths of the vermiform appendix are so unusual and hitherto have received so little attention that each case is worthy of being recorded. The following cases, one of primary origin, the other secondary to an ovarian tumor, have recently occurred in the service of Dr. Kelly, to whom I am indebted for the privilege of making this report. Apart from its rarity the first case is of interest on account of the early stage in which it was discovered owing to the routine examination of the abdominal viscera made in all cases of abdominal section. The second case was also detected by this general examination.

In the literature there are references to ten cases of carcinoma originating in this organ. Of these, however, only the three cases in which the diagnosis was confirmed by a microscopic examination can be accepted as well established. These were shown to be of the usual type of carcinoma of the intestines. In two cases the growth had penetrated the abdominal walls appearing externally as large crater-like ulcers with thick irregular margins.

In Thiersch's case, reported by Bejer, the extension had taken place along a sinus which had persisted for three and one-half years after the opening of a large pus-sac in the right iliac fossa. On partly removing the external mass a finger-thick cord was disclosed which extended down into the peritoneal cavity. This proved to be the vermiform appendix, and in the cecum a tumor the size of a walnut could be felt surrounding the orifice of the appendix.

The writer calls especial attention to the early formation of adhesions and infiltration of the abdominal wall and to the absence of intestinal symptoms. He is of the opinion that the growth began in the apex of the appendix and slowly extended along the mucosa to the cecum.

In the case described by Kolaczek the right lumbar region presented a deep ulceration, at the base of which was the denuded os illi. At autopsy the appendix was found to be destroyed by a tumor which had invaded the walls of the cecum, and also the surrounding cellular tissue and the psoas muscle.

Morse and Daumie report a case occurring in a woman 50 years old who had died of heart-disease. The vermiform appendix floated free in the peritoneal cavity, was 4 cm. long, 4.5 cm. in circumference, and cylindrical in shape. On transverse section the muscular layers could be seen enclosing a hard mass within which was a narrow canal opening into the cecum. The tumor did not project at all into the cecum and was limited to the appendix. Histological examination showed the muscular coats for the most part normal, but in places separated by small islands of epithelial cells. The peritoneal coat was normal. In the central part of the tumor near the canal were seen remains of the mucosa and of Lieber-

kühn's glands. The latter had for the most part undergone cancerous transformation and were probably the origin of the neoplasm. No other growth was found.

Carcinomata occurring in the vermiform appendix are of the two varieties commonly observed in growths affecting the alimentary canal, namely, colloid carcinoma and adenocarcinoma with glands resembling proliferating glands of Lieberkühn. An unusually large proportion of the cases occurring in the appendix if we accept the diagnosis made from the gross specimen are of the colloid type.

The clinical notes on the present case are briefly as follows:

Gyn. No. 6646. Mrs. G. Age 24. Married 9 years. II para. The oldest child 8 years, the youngest 3 years old. 2 miscarriages, the first six years ago, the last in August, '98. Her family history is unimportant, with the exception that one brother died at the age of 18 after amputation of the leg for a "cancer."

The patient had always enjoyed excellent health until the birth of her first child. At varying intervals thereafter she suffered pain in the lower part of the abdomen and back. The pain was described as aching or dragging in character and was most severe the week preceding and following menstruation. Last spring the patient had a fall and afterwards the pain which previously had been limited to the pelvis became more marked higher up in the right iliac fossa and was associated with constant aching in the right lumbar region. This was ascribed by her physician to a floating kidney which was found to be present. Her appetite failed and at times she suffered from nausea and vomiting.

On palpation the abdomen was non-resistant, and there was no tenderness in either iliac fossa. The right kidney was palpable and slightly movable; on bimanual examination the uterus was found in acute retroflexion and its mobility was restricted. Further examination was negative.

Operation by Dr. Kelly, Feb. 21st, 1899. Release of pelvic adhesions; suspension of the uterus; removal of the vermiform appendix.

The uterus was found retroflexed and bound down by a few light adhesions. The tubes also presented a few adhesions somewhat stronger on the right than on the left side. Apart from these adhesions the tubes were perfectly normal and no cause for the pelvic peritonitis could be discovered until on looking for the appendix it was found hanging down into the pelvis over the right infundibulo-pelvic ligament and enveloped in dense vascular adhesions. A shortened mesentery caused the outer third to redouble on the inner portion, and at the point of flexion there appeared to be a foreign body in the canal.

The appendix was amputated close to the cecum, the uterus

and tubes freed from adhesions and the uterus suspended. The abdomen was then closed in the usual way.

The patient made an uneventful recovery and was discharged March 16th. In a letter written Dec., '99, she stated that she had gained twenty-three pounds and her general health was excellent. She suffered, however, from some discomfort in the right lumbar region, probably owing to the movable kidney.

Pathological report: Gyn. path. No. 2854. The appendix is 10 cm. long. At the junction of the middle with the outer third it is slightly flexed and held in this position by broad velamentous adhesions. The proximal end is practically normal but the part beyond the flexion is distended, having a diameter of 12 mm. and contains a soft concretion of about the size and shape of a date-stone. The walls here are thinned, averaging not more than 1 mm. Their internal surface is smooth. Joining the distended extremity to the normal inner half of the appendix is an intermediary portion about 1.5 cm. long, of firm consistency. Previous to removal this was supposed to contain a concretion but on transverse section it is seen that the lumen is practically obliterated by a small oval swelling which impinges upon the canal so that merely a small crescentic slit remains. This is displaced toward the inferior border of the appendix by the tumor which encroaches from above. To the naked eye this minute tumor appears to be about 1 cm. long, and 5 mm. in its greatest thickness. Its cut surface presents a whitish dense appearance and is partly homogeneous, partly finely striated. It is enclosed by the muscular coats into which its external margin imperceptibly merges.

**HISTOLOGICAL EXAMINATION.**—In a transverse section through the portion of the appendix occupied by the new growth it is seen that all its coats to a greater or less extent are infiltrated with epithelial cells in the form of nests or cylinder-like processes. The muscular coats are not thickened and the epithelial processes which here are slender and cord-like invade the interstitial connective tissue while the muscle bundles remain unaffected. The epithelial proliferation is most evident in the mucous and submucous layers, which are markedly thickened, forming a rounded prominence which encroaches upon the central canal. The cells in this portion are arranged in oval or irregular masses, or in parallel columns consisting of three, four or more rows of cells. The intervening stroma is scanty and indeed the epithelial masses are sometimes directly contiguous. In the center of the column of cells a narrow central canal is sometimes faintly visible, and in the larger masses the cells are now and then seen to be disposed in little circles which may present a minute central lumen. Extending downward from the surface of the mucosa there are a few normal glands of Lieberkühn. Others which are found here and there between the cancer nests show beginning proliferation and alteration of the character of the epithelial cells and are undergoing early carcinomatous changes. The starting point of

the growth has probably been in the area included between points p. and c., Figure 2, as here all the glands have been replaced by masses of tumor cells.

The surface epithelium of the mucosa has not taken part in the tumor-formation and is intact, though where the growth impinges upon the canal the cells are flattened. The mucosa lining the opposite side is attenuated and its glands shallow and few in number but the epithelial cells exhibit no tendency to become proliferated and are unaltered in appearance. The lymph-nodes have disappeared. The submucosa is scanty. Both circular and longitudinal muscular coats are of normal thickness.

On higher magnification the tumor-cells are seen to be fairly uniform, the peripheral layer of the nests consisting of low columnar, the central mass of oval cells. Where the minute lumina are present in the cell masses they are also lined with low columnar cells. The cell nuclei are oval or spherical and are vesicular. Their chromatin is finely granular. There are, however, various large cells containing deeply stained hyperchromatic nuclei which are coarsely granular. Mitotic figures exhibiting the different stages of cell-division are moderately numerous.

The invasion of the muscular and peritoneal coats is associated with but little inflammatory reaction, but the mucous and submucous layers show a marked leucocytic infiltration and it is noteworthy that a considerable proportion of the infiltrating cells are eosinophiles.

In the superior segment of the appendix, that is, the portion farthest from the mesenteric attachment, the growth has penetrated all its coats extending to the peritoneum, which contains many large round or oval cell-nests, d. Fig. 2, but the inferior segment has apparently been invaded only in the circular muscular tunic where a few strands of epithelium extend almost entirely around, running parallel with the muscle fibers.

The various coats of the cystic extremity of the appendix though thinned out preserve their normal proportions. Its inner surface is smooth and even, and its epithelial lining intact. The glands are diminished in number and shallow but otherwise unaltered; the stroma scanty and the lymph follicles atrophic and widely separated from one another.

The cecal half of the diverticulum is normal in all respects.

The first cause of the formation of carcinoma affecting any organ remains to be discovered, but the presence in this case of the fecal matter suggests an important question as to the etiological significance of foreign bodies in the development of tumors. The occurrence of new growths of the bile-passages and kidneys with calculi intimately associated has frequently been observed and a few tumors of the appendix have been described which had developed around foreign bodies as their centers. An instance described by Lafforgue is a small lipoma situated in the wall of the appendix which contains a small concretion in its center.

Gilford reported a case of sarcoma surrounding a concretion in the appendix, the growth having apparently resulted from





FIG. 1. Primary carcinoma of the appendix. The position and caliber of the canal are indicated by the dotted lines beginning at *a* and extending to the apex. *b* shows the dilated extremity. Between *b* and *c* is an indurated portion gradually merging into the normal.

The flexion is not so acute as before cutting the mesentery.

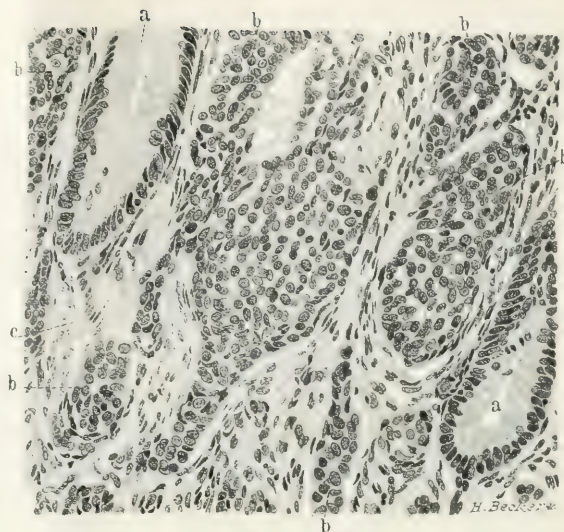


FIG. 3. A higher magnification of a small area in Fig. 2, carcinoma of the appendix 350 diameters. Two glands of Lieberkuhn are seen at *a*, and masses of carcinoma cells at *b*; *c* indicates the stroma.

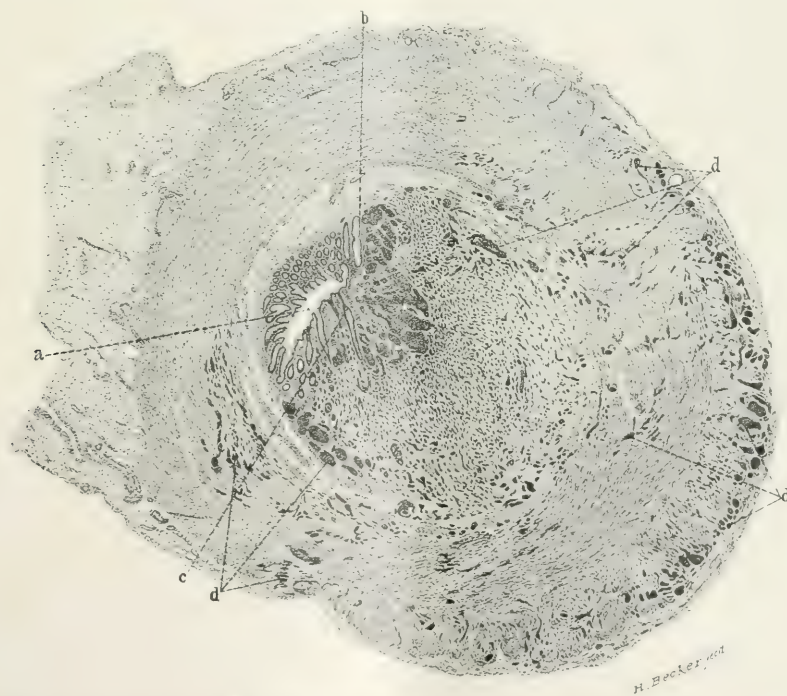


FIG. 2. Transverse section of carcinoma of the appendix 12 diameters. The canal of the appendix is seen at *a*. On the left side the mucosa and submucosa are practically normal. A few clusters of deeply stained tumor cells are present in the circular muscular coat; the longitudinal muscle and mesentery are normal. On the right between *b* and *c*, the glands of Lieberkuhn have been replaced by the neoplasm, and islands of tumor cells, *d*, are scattered through the remaining coats.



a previous appendicitis. The tumor was removed with a portion of ileum and colon to which it was adherent and the patient made a good recovery. On cutting open the tumor three or four small collections of pus were laid open and in one near the middle of the mass was a fecal concretion twice the size of a cherry-stone. A probe passed into this cavity passed down the appendix vermiformis into the cecum. The microscope showed principally large oval and spindle-shaped cells, and the growth was considered to be an undoubted sarcoma. A small nodule was also excised from the right psoas.

In the cases of carcinoma of the appendix reported in the literature one writer mentions that a fecal concretion was present in the dilated extremity, the growth in this case affecting the cecal end. In our case the foreign matter is of softish consistency and there is no evidence of irritation of the epithelium lining the canal at any point. It is conceivable, however, that the presence of the body with the impossibility of expulsion due to the kink has in some way incited the atypical glandular proliferation.

Several of the cases quoted gave histories of attacks of acute appendicitis occurring some years before the discovery of the cancer.

**DIAGNOSIS.**—The difficulty of diagnosis in carcinoma of the appendix is indicated in the histories of the cases quoted above and is owing to the absence of distinctive symptoms in the early stages. Our attention is first directed to the iliac region by the onset of pain and the presence of tumefaction, and when these are manifest the growth is usually well advanced. As a rule there is no interference with the digestive function until the growth has invaded the cecum or the large or small intestine. This was observed in only two cases late in the course of the disease. The most constant symptom is the presence of a dull pain of a not severe type affecting the right iliac region and extending to the right groin and thigh. On making a physical examination a firm mass is found occupying the position of the appendix vermiformis. This is usually cylindrical and before adhesions have formed is freely movable within a limited radius. The appendix, however, may be small and nodulated as in the cases of scirrhus carcinoma and is then hardly to be distinguished from a calculous appendix. The diseases for which carcinomatous appendix is most apt to be mistaken are: cyst of the appendix, calculi, tuberculosis of the so-called neoplastic form, impacted feces in the cecum or small intestine. Floating kidney was diagnosed in the case of sarcoma of the appendix recorded by Gilford.

In many instances only an exploratory section will enable one to make a positive diagnosis.

**PROGNOSIS.**—If we should consider the prognosis of carcinoma of the vermiform appendix from the standpoint of the outcome in the cases reported it would be rendered extremely grave. It must be remembered, however, that the majority of these cases were observed in an early time and before the period in which operative interference began to be so gener-

ally employed. Moreover in one case death was due entirely to an intercurrent affection and in three other cases we do not know that the growth was in any way responsible for the fatal termination. On the other hand, however, the absence of functional symptoms and the little pain excited by the presence of the growth may cause it to be overlooked until the surrounding tissue has been invaded or until rupture occurs, and in the latter case the ensuing general peritonitis is itself attended with serious consequences. In the present time when the vague pains accompanying mild affections of the appendix are more carefully investigated and when operative interference is more generally employed for the relief of such cases the prognosis in carcinoma is rendered more favorable as it is for this class of cases that early carcinoma is liable to be mistaken.

**TREATMENT.**—There is little to be added regarding the treatment in cases of carcinoma, as when the symptoms or the results of the physical examination warrant the assumption that the appendix is diseased, the safest course is to perform an exploratory section, and if the suspicion is verified, to remove the appendix. If the appendix is found to be the seat of a new growth in order to insure its complete removal the head of the colon should be resected and should the growth have visibly extended beyond the appendix a more extensive resection may be indicated. In cases still further advanced and involving the abdominal fasciæ a radical cure can scarcely be expected and the patient receives little benefit from an incomplete removal of the tumor.

**SECONDARY CARCINOMA OF THE APPENDIX.**—Secondary carcinoma of the appendix is of interest chiefly from the scientific standpoint, since clinically, as it gives rise to no symptoms or to none that are characteristic, its presence is masked by the primary tumor. Moreover, if detected its removal does little to stay the progress of the disease. Metastatic carcinomatous growths in the appendix appear to be almost as rare as the primary cases, most of the secondary growths consisting of direct extensions from the cecum. The most frequent seat of the original tumor appears to be in the ovaries, the stomach or other portion of the digestive tract, or the uterus. The growth in the appendix corresponds in structure to the original tumor.

The case I have to report was discovered at operation for removal of a large ovarian tumor, and at the same time it was found that the pyloric end of the stomach was also the seat of a new growth.

Gyn. No. 5262. Mrs. S., age 57 years, was admitted to the gynecological service complaining of an abdominal tumor associated with some pain in the lower abdomen and a slight sanious discharge of about six months' duration. She was a healthy-looking woman, her appetite was good but she suffered from slight indigestion and chronic constipation. Further than this her history is unimportant.

**Operation by Dr. Kelly.**—Removal of both ovaries and tubes and the vermiform appendix.



The left ovary was transformed into a large oval tumor of remarkably dense structure. On microscopic examination this was found to consist of small round or oval glands imbedded in a dense cellular connective-tissue stroma. The glands were lined with low columnar or flattened epithelial cells with protoplasm stained deeply with eosin and containing large nuclei of variable shape and intensity of color. The epithelium was mostly disposed in one layer but occasionally two or three layers were seen.

The remaining pelvic organs appeared normal with the exception that the mesosalpinx of each side was thickened and the peritoneal surfaces of the broad ligaments and uterus were studded with a few small flat white nodules. One of these was excised and examined under the microscope showing only fibrous tissue but doubtless further sections would have revealed their carcinomatous nature. Microscopic examination of the right ovary showed that though not enlarged it was also invaded by the new growth which was limited to two well-defined areas immediately beneath the albuginea, and a small area in the hilus.

The vermiform appendix was found to be thickened, nodular and very rigid in its outer half, the cecal half being normal. The mesenterium was indurated. On cutting open the appendix its outer third was found to be slightly distended, containing a small fecal concretion. Internally to this there is a nodular enlargement 1 cm. in diameter formed by the general thickening of all its coats. The lumen here is constricted. The proximal half is of normal caliber.

Histologically, excepting in the thickened median portion of the appendix, nothing of importance is noticed. At this point there is a marked hyperplasia of the lymphoid ele-

ments of the mucosa and submucosa and on the side to which the mesentery is attached the peritoneal, muscular and submucous layers are infiltrated with a carcinomatous growth similar to that in the ovary, while here and there in the muscular coats generally are small islands of carcinoma cells sometimes contained in vessels, but whether lymph channels or veins is not determined. A few light adhesions are attached to the surface of the appendix, and in one of these there is a small nest of carcinoma cells. The mesenterium is also invaded by the growth chiefly in its outer half.

In this case it is probable that the carcinoma cells were carried through the peritoneal lymph spaces to the mesenterium and thereupon invaded the various coats of the appendix. This view is maintained by the occurrence of the few superficial nodules distributed over the peritoneum which are probably metastatic, as the main tumor is enveloped in a smooth fibrous capsule and not apt to give rise to implantation growths, and from the fact that the principal focus of invasion is at a point contiguous to the mesentery, which is also extensively involved in its corresponding portion.

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## A CASE OF TRANSIENT SPASTIC CONVERGENT STRABISMUS.

BY SAMUEL THEOBALD, M. D.,

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Spastic convergent strabismus, or strabismus from tonic spasm of the internal recti muscles, a condition to be sharply differentiated from ordinary concomitant convergent squint and from squint due to paralysis of the abducens, is one of the well-recognized ocular manifestations of hysteria; but, apart from this, it would seem, deserves to be regarded as a rare anomaly, to which, as a rule, the text-books upon diseases of the eye devote but scant attention.

Dr. Schweinitz, in the paragraph of less than five lines which he devotes to "spastic strabismus," † says that it "occurs only under rare circumstances in hysteria and brain dis-

ease (meningitis). It is difficult of diagnosis, periodical-concomitant squint in hypermetropia being sometimes inaccurately described as due to spasm of the internal rectus (Mauthner)." Jackson, in a paragraph of equal brevity, says "deviations of the eyes due to spasm of the ocular muscles attend hysterical seizures and some forms of brain-disease. They may assist in the general diagnosis, but have little localizing value, and require no treatment apart from that of their cause." \*

Fuchs, though he states that "tonic spasms of the ocular muscles are extremely rare," adds that "many cases of intermittent strabismus belong under this head," and he mentions two cases of this character which he had observed in

\* A paper read before the American Ophthalmological Society, May 3, 1900.

† Diseases of the Eye, third edition, p. 554.

\* Diseases of the Eye, p. 234.

hysterical women.\* Roosa says children, in whom optic neuritis is found to be present, are often brought to ophthalmic clinics with strabismus in its early stages which is non-paralytic. "Every careful observer," he adds, "will take great pains to determine in a given case of suddenly occurring strabismus, that there is not some cerebral lesion. During dentition, certain children are apt to squint." This, he thinks, "may fairly be ascribed to cerebral irritation." † Duane, in his chapter upon "movements of the eyeballs and their anomalies," in De Schweinitz and Randall's American Text-Book of Diseases of the Eye, Ear, Throat and Nose (p. 511), treating of paretic and spastic squint, says "spasm, which is much less frequent than paralysis, is due to irritative lesions (meningitis, etc.), chorea, epilepsy, and hysteria; rarely is idiopathic." Noyes, Norris and Oliver, Fick, Nettle-ship and Swanzy, so far as revealed by a glance through their respective treatises upon diseases of the eye, make no mention of the subject of spastic strabismus.

In Norris and Oliver's System of Diseases of the Eye, Parinaud, treating of the ocular manifestations of hysteria, considers at some length the "anomalies of convergence" occurring in this condition. If we would understand the anomalies of the movements of the eyes in hysteria, we must, he says, "consider that neither muscles nor nerves, but nerve centers, and, indeed, the higher centers, are affected—those whereby the movements themselves are brought into unison with psychic action"; and, he adds, "another fact connected with a study of hysterical disorders of the ocular apparatus is that they are almost always of the nature of contractures, even when they present the objective characteristics of paralysis." ‡ In the same volume (pp. 708 and 710), Santos-Fernandez, writing of the "ocular manifestations in influenza," mentions cases of paralysis of the third and sixth nerves and of "convergent strabismus" as having been observed in this affection, while Culver, in the chapter upon "Anomalies of the motor apparatus of the Eye," says "Changes in the centers of innervation as *primary* causes of strabismus are admissible only in certain definite cases," and, again, "Convergent strabismus may be due also to a *spasm of convergence*, independently of accommodation and refraction. We have observed cases of this kind in hysteria. It is perfectly admissible that the same phenomenon is produced in consequence of other irritations of the center of convergence." §

Briefly described, the case which I wish to report is as follows:

A little girl, seven years of age, convalescing from a pronounced attack of influenza, a marked feature of which had been persistent and severe headache, and during the course of which an otitis media had developed in the right ear, complained of diplopia, and on the following day exhibited an evident squint. At the request of the attending physician,

Dr. W. D. Booker, I saw the case on the second or third day after the squint manifested itself.

There was present at this time, in both distant and near vision, a very decided convergent squint of the left eye. There were no signs of paresis of either rectus externus—each eye could be rotated outward farther than is commonly possible, and neither the extent of the squint nor the diplopia was influenced by the direction in which the head or the eyes were turned. The pupils were of normal size and there were no signs of either paralysis or spasm of the ciliary muscles. The ophthalmoscope revealed a hypermetropia of rather more than 2 D., and, as I had previously performed a tenotomy upon the little patient's mother for a pronounced esophoria, I concluded that the influenza had been the straw which had broken the camel's back, and developed a concomitant squint in a child who had, probably, inherited insufficiency of the external recti muscles and who was decidedly hypermetropic. That the trouble would be overcome without glasses or an operation seemed to me highly improbable. Dr. Booker had already prescribed iron and quinine and a nourishing diet, and the general condition of the patient was improving from day to day.

At my second visit, four days later, although the mother reported that the eyes had been straight at times during this interval (?), I found the squint unchanged except that it showed, perhaps, a greater tendency to alternate. Thinking that suppression of the accommodation might favorably influence the squint, I directed a two-grain solution of atropia to be dropped into the eyes twice a day. Two days subsequently, the eyes being thoroughly under the influence of the atropia, the squint seemed somewhat less marked. My next visit was five days after this, and, to my gratification, I then found no trace of the squint remaining. Not only so, but even with the cover test it showed no disposition to recur, and an esophoria for distance of only four degrees was shown by the Maddox rod. A decided change for the better in the general condition of the patient was also evident.

After another interval of four days, the eyes meantime having remained quite straight, the atropia was discontinued, although, I confess, I still had serious misgivings as to what would occur when the ciliary muscles began to regain their activity. However, my apprehension proved to be groundless, for a week elapsed without any recurrence of the squint, by which time she had recovered her power of accommodation sufficiently to be able to read ordinary print. The Maddox rod now showed an esophoria for distance of only 3°, while, more noteworthy still, the vertical diplopia test showed at 12" a so-called exophoria of 4°—a practically normal muscle balance. Since then the eyes have given no further trouble.

A few days since (April 26th), nearly two months having elapsed since the disappearance of the squint, the muscle balance was tested with the following result:

Esophoria 20' = 1°	} Rod test.
No hyperphoria 20'	
Exophoria 12" = 1° (Vertical diplopia test).	

\* Text-Book of Ophthalmology, p. 576.

† Diseases of the Eye, p. 553.

‡ Vol. IV, p. 754.

§ Op. cit., p. 100.

That the squint in this case was a purely spastic one, due, doubtless, to an irritation (of influenzal origin) of the innervation center which controls the associated action of the internal recti muscles, is, in my judgment, not open to question. Had it been a concomitant squint, precipitated by the attack of influenza, as I at first supposed, it might, indeed, have disappeared under the influence of the atropia and with the improvement in the patient's general condition; but, under such circumstances, a normal muscle balance would certainly not have been reestablished in the space of a few days, as actually happened. On the contrary, a marked, and probably persistent, esophoria would certainly have been encountered.

As to abductor paresis, I have already said there were no signs whatever pointing in this direction; but, apart from this

fact, the rapid return of the lateral muscles to a condition of practical orthophoria, is as little consistent with this view of the case as it is with the view that the squint was a concomitant one.

An incomplete search through the literature of the subject has revealed only one case which bears a close resemblance to my own. In the Archives of Pediatrics, Vol. 1, p. 634, Dr. Samuel S. Adams, of Washington, reports an interesting case of convergent strabismus as a sequela of diphtheria, in which paresis of the external recti muscles was excluded, and which he attributed to "a spasm or over-action of the internal rectus" due to an irritation of the center of ocular adduction. The squint disappeared completely within a few days of its onset.

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HUNTER ROBB, M.D. The Results of Modern Aseptic Surgical Technique.—*American Journal of Obstetrics*, May, 1900.

——— Ligatures and Sutures in Abdominal Surgery.—*Cleveland Medical Gazette*, June, 1900.

STEWART PATON, M.D. The Hospitals for the Insane and the Study of Mental Diseases.—*Philadelphia Medical Journal*, May 26, 1900.

WILLIAM H. WELCH, M.D. Argument against Senate Bill 34, Fifty-sixth Congress, First Session, Generally Known as the "Antivivisection Bill."—*Journal of the American Medical Association*, May 19, and May 26, 1900.

R. L. RANDOLPH, M.D. Diseases of the Iris, Ciliary Body and Choroid; Sympathetic Inflammation and Irritation.—*An American Text-Book of Diseases of the Eye, Ear, Nose and Throat*, Philadelphia, 1899.

——— A Critical Review of German Ophthalmic Literature for the Quarter ending March 31st, 1900.—*Annals of Ophthalmology*, April, 1900.

——— Otology: A Digest of the Advances, Discoveries and Improvements in this Science during 1899.—*Progressive Medicine*, March, 1900.



**BOOKS RECEIVED.**

- Archives of Neurology and Psychopathology.* Vol. 2. Nos. 3-4, 1899. 8vo. 321-585 pages. State Hospitals Press, Utica, N. Y.
- A Handbook for Nurses.* By J. K. Watson, M. D. Edin. American Edition under the supervision of A. A. Stevens, A. M., M. D. 1900. 12mo. 413 pages. W. B. Saunders, Philadelphia.
- American Laryngological Association.* Transactions of the Twenty-first Annual Meeting held in the City of Chicago, Ill. May 22, 23, and 24, 1899. 8vo. 233 pages. 1900. D. Appleton and Company, New York.
- Proceedings of the American Medico-Psychological Association at the Fifty-fifth Annual Meeting held in New York, May 23-26, 1899.* 8vo. 437 pages. Published by the American Medico-Psychological Association.
- Transactions of the American Pediatric Society.* Eleventh Session held at Deer Park, June 27, 28 and 29, 1899. With the Constitution. Edited by Floyd M. Crandall, M. D. Volume XI. 1899. 8vo. 252 pages. Reprinted from the Archives of Pediatrics.

**NOTES ON NEW BOOKS.**

*Surgical Pathology and Therapeutics.* By JOHN COLLINS WARREN, M. D., LL. D., Professor of Surgery in Harvard University; Surgeon to the Massachusetts General Hospital. Second edition. (Philadelphia: W. B. Saunders, 1900.)

The writings and reputation of the author of this much-needed book are sufficient to warrant a scientific, practical and very useful work on surgical pathology. His physiological and pathological knowledge combined with his great experience in teaching are evident throughout the book. These make it not only a valuable text-book but also a reference-book because of the thoughtful combination of physiological and pathological knowledge with a fairly extensive use of historical and biographical references. There is a great present need of this book, which will be a guide to workers and a model on which future writers may build—adding here and there a few innovations in methods, if not in materials.

The new edition differs from the first one only in the addition of a more extensive appendix which is designed to act as a clinical guide in working up surgical cases. It also contains what is not commonly found in surgical works—an article which may bring it into the hands of the dental surgeon. This is a very useful section on the bacteriology of the mouth and how to prepare for filling teeth.

Bacteriology may be considered completely treated when we add to the detailed work on bacteriological technique and surgical bacteria of the main body of the book, the appended bacteriology of the skin, pleura, joints, bladder, eye, ear and nose, and a paragraph on bacteriological examinations.

Omissions made in the original are supplied in the appendix.

It was a notable oversight in the first edition not to speak of one of the most important of the surgical bacteria, the *Bacillus Aerogenes Capsulatus* (Welch), and the omission of the *Gonococcus* as a cause of peritonitis. This has been rectified in the appendix and the *Pneumococcus* and *Typhoid bacillus* are given more scope as surgical bacteria.

A valuable introduction to the article on inflammation is given in Chap. III on Hyperemia in which the relationship between physiology and pathology is clearly brought out.

The chapter on inflammation is a type of the work, being eminently practical and scientific. The references to works on the subject are full but not too extensive.

It is worthy of note that after reviewing so usefully and

thoroughly the writings of those most worthy of quotation the author ends his chapters with his own healthy view of the subject.

Infective inflammation is dealt with in three chapters. This differs from the simple form in that it is due to bacteria and spreads, usually ending in suppuration. The etiology is included with some practical points on invasion of tissues. Under the same head comes *Acute Osteomyelitis* with a very useful, complete description of the local action of the infective process. The various causative agents and their differences in action with the change in the part acted on are noteworthy. Repair is sharply separated from inflammation, as it should be. The nervous theory of shock gets greatest credit after a historical review of the subject.

In five chapters the author gives a clear portrayal of the fevers of surgery, the physiological basis preceding the pathological condition being first described. Traumatic, Aseptic and Urethral Fevers, Septicæmia, Pyæmia and Erysipelas come under this head. Tetanus is thoroughly treated of in a special chapter; its bacteriology and treatment by antitoxins being described in other chapters.

Tuberculosis of bone is well handled—the manifold pathological appearances and clinical pictures being given in a concise, yet complete manner. The experimental work stands forth prominently—Cheyne and Krause getting credit for much good work.

Under tuberculosis of joints Warren very properly adheres to Cheyne's view that there are two forms, one beginning in the joint, another being primary in the bone. In the treatment of abscesses the healing power of iodoform is asserted.

Chapter XXVI deals with tuberculosis of the soft parts, including the peritoneum, glands and genito-urinary tract. Diseases of bone have a special chapter and include all of the diseases not dealt with under the headings *Osteomyelitis*, *Tuberculosis*, and *Tumors of Bone*—there are many of them. *Osteospathyrosis*, *Senile Atrophy* and *Osteoporosis* are said to denote closely allied conditions of bone, the absorption of the bone being due to "lacunar absorption." *Neuroparalytic Atrophy*, that due to the pressure of aneurisms and to malignant growths, is included under the heading *Osteoporosis*. Nearly all known diseases of bone are included in this chapter.

It is remarkable how the author has managed to include all the practical points of surgical pathology in some way, leaving out no important ones. If not found in their natural places they turn up somewhere else.

There is nothing of special note in the chapter on Tumors. The classification is the simplest possible. *Endothelioma* is classed with *Carcinoma*; yet, when writing about *Sarcoma*, it is shown how the endothelial tumors are closely related to them. The theories of tumor-formation are discussed, especially the parasitic theory, which still remains not proven.

In describing *Sarcoma* and *Carcinoma* each organ and locality of the body is taken up in order, with its peculiar tumor growths. The use of the Mixer punch in settling the question of malignancy of a new growth might be criticised.

Besides the surgical treatment of *Carcinoma* the author is not sure but that something may develop from the work on the injections of cancerin—extracted from cancer cells as recommended by Adamkiewicz.

A few drawings of macro- and micro-scopic aspects of tumors are given but no special merit is noted in the illustrations.

The appendix has been written to fill in what did not fit well in the main body of the book and to give the special bacteriology of various localities and organs.

It is well that it was added, if for no other reason than the addition of a useful article on peritonitis. The old edition only alludes to peritonitis of tubercular origin.

Here too are added certain good points on pathological technique and clinical microscopy and corrections are made of oversights in the main body of the book. Subjects not usually treated of in surgical text-books are here brought forward.

In the chapter on Scientific Aids to Surgical Diagnosis, which is a rather overcrowded article, after insisting that the surgeon should know enough of laboratory methods to be able to say which of them can give him positive results in case a specimen is sent for examination, he refers to some things to be learned from blood-examinations; gives some points in bacteriological technique, and speaks of the necessity for animal inoculation. In this chapter a great number of bacteriological data, urinary symptoms and findings are crowded together in marked contrast to the clearer writing of the original edition.

To the Röntgen rays is devoted a special article describing their value in detecting fractures, foreign bodies, calculi, etc. Their advantages and disadvantages are referred to, and several illustrations are added.

Chapter II deals with the surgical bacteriology of the skin, and treats of wound-infection and disinfectants in a brief and practical manner. Useful points in technique, such as the preparation of ligatures, of the patient, of instruments, of the surgeon, and the treatment of the wound, not included in the original are found here. Serum therapy is also dealt with in its relation to tuberculosis, tetanus, syphilis and streptococcus infections.

The contents of the whole volume are of the greatest value, and the matter is presented in a very interesting manner by one who is a master and teacher.

The Medical Annual and Practitioner's Index, 1900. (*J. Wright & Co., Bristol, and E. B. Treat & Co., New York.*)

The present number, the eighteenth of its publication, is well up to the standard of previous years. In recently noting the Synoptical Index of this work for the years 1887-1898 we commented on its valuable features. The extracts and notes of articles are usually well made, some of them giving the important points more clearly than they are given in the original articles. Special attention may be drawn to the section on Malarial Fever, by Major Ronald Ross. It gives an excellent short account of the recent work on that subject. Colonel Keith Hatch contributes an interesting article on Mycetoma which is well illustrated. To those who have used the Annual its good points are well known. It may be recommended to those who do not know it as being helpful in many ways.

Pye's Surgical Handicraft. Fourth edition, revised and enlarged, by BERTRAM ROGERS, M.D. (*John Wright & Co., Bristol, 1900.*)

It is a pleasure to see another edition of this work, eight years having elapsed since the third edition. It was first published by the late Mr. Pye, in 1884, and some words of his original preface regarding the title of the work may be quoted: "Although surgery is doubtless becoming more scientific day by day, nevertheless it will never cease to be a skilled labor nor will surgeons ever cease to be handicraftsmen." His object in the book was to describe the details of surgical work from the point of view of house surgeons and "dressers" in the surgical wards. With this purpose the work is thoroughly practical and the descriptions are plain and accurate. At the time when one is first battling with the many difficulties and emergencies that come to the young house officer, this book is a great help. There are few surgical conditions that are not described and the advice given is usually sound. Every senior student and young graduate will find this work useful. We speak with grateful remembrance of its assistance in days gone by when one dwelt

with the fear of an improperly treated emergency ever before his eyes.

Injuries to the Eye in their Medico-Legal Aspect, by S. BAUDRY, M.D., Professor in the Faculty of Medicine, University of Lille, France; translated from the original by ALFRED JAMES OSTHEIMER, JR., M.D., of Philadelphia, Pa.; revised and edited by CHARLES A. OLIVER, A.M., M.D., Attending Surgeon to the Wills Eye Hospital, Ophthalmic Surgeon to the Philadelphia Hospital, Member of the American and French Ophthalmological Societies, etc., With an Adaptation of the Medico-Legal Chapter to the Courts of the United States of America, by CHARLES SINKLER, ESQ., Member of the Philadelphia Bar. (*Philadelphia, New York, Chicago: The F. A. Davis Company, Publishers, 1900, pp. X-161. Price \$1.*)

It is not long since that we had the pleasure of perusing another of Prof. Baudry's contributions, "Simulated Blindness" in The System of Diseases of the Eye, by Norris and Oliver (Vol. IV), and perhaps the Lille professor is best known to many of his American readers as one of the contributors to that standard work on ophthalmology.

American ophthalmologists seem to be less familiar nowadays than formerly with what is going on in the domain of French ophthalmology, a condition of affairs which is to be attributed to the fact that in this branch of medicine more than ever before inspiration is being drawn from Germany. We should not forget, however, what de Wecker, Panas, Landolt and Meyer have done and that they are still working at the very front.

The object of Professor Baudry's work is to equip the ophthalmologist with a medico-legal knowledge of injuries to the eye. It is surprising that ophthalmic literature is so poor in information of this character. The author has collected his personal observations and compiled the reports and published conclusions of others upon this subject. It is a short work consisting of scarcely one hundred and fifty pages and is full of practical information. The contents will not strike one as being something which is entirely new, for the clinical facts, at least, with which every page is full, are all old stories and form part of the mental equipment of every experienced ophthalmologist. The book will be useful, however, because it contains these clinical facts condensed and so arranged as to form what may be regarded as a distinct and important chapter in ophthalmology, "Eye Injuries." It is needless to say that such a presentation of the subject leaves a clear impression.

In its application to the legal status or value of an injury to the eye it is to be hoped that the work will be found useful, though we doubt whether it can be regarded as a preeminently valuable guide to the expert in estimating accurately the damage caused by the injury to the individual. Such a work we think ought to contain more clinical records with the legal points to which they give rise, and should be illustrated by pertinent cases with their legal conclusions or decisions.

It is divided into four parts: 1. "Traumatic Lesions of the Ocular Adnexa." 2. "Traumatic Lesions of the Eyeballs." 3. "Simulated or Exaggerated Affections of the Eye." 4. "Medico-Legal Expert Testimony."

We look upon Part Third, which treats of a theme on which Baudry is a recognized authority, as the best in the book; that is, from a medico-legal point of view. Professor Jacquey, of Lille, has contributed the legal portion of the last chapter, which is to the point and is an epitome of the principles which govern opinion-evidence and will be found to contain what every practitioner of medicine should know.

In conclusion we are happy to bear witness to the readability of Doctor Ostheimer's translation and to this further token of the industry of Doctor Oliver, the editor.

R. L. R.



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In the methods of instruction especial emphasis is laid upon practical work in the Laboratories and in the Dispensary and Wards of the Hospital. While the aim of the School is primarily to train practitioners of medicine and surgery, it is recognized that the medical art should rest upon a suitable preliminary education and upon thorough training in the medical sciences. The first two years of the course are devoted mainly to practical work, combined with demonstrations, recitations, and, when deemed necessary, lectures, in the Laboratories of Anatomy, Physiology, Physiological Chemistry, Pharmacology and Toxicology, Pathology and Bacteriology. During the last two years the student is given abundant opportunity for the personal study of cases of disease, his time being spent largely in the Hospital Wards and Dispensary and in the Clinical Laboratories. Especially advantageous for thorough clinical training are the arrangements by which the students, divided into groups, engage in practical work in the Dispensary, and throughout the fourth year serve as clinical clerks and surgical dressers in the wards of the Hospital.

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As candidates for the degree of Doctor of Medicine the school receives:

1. Those who have satisfactorily completed the Chemical-Biological course which leads to the A. B. degree in this university.
2. Graduates of approved colleges or scientific schools who can furnish evidence: (a) That they have acquaintance with Latin and a good reading knowledge of French and German; (b) That they have such knowledge of physics, chemistry, and biology as is imparted by the regular minor courses given in these subjects in this university.

The phrase "a minor course," as here employed, means a course that requires a year for its completion. In physics, four class-room exercises and three hours a week in the laboratory are required; in chemistry and biology, four class-room exercises and five hours a week in the laboratory in each subject.

Those who give evidence by examination that they possess the general education implied by a degree in arts or in science from an approved college or scientific school, and the knowledge of French, German, Latin, physics, chemistry, and biology above indicated.

Applicants for admission will receive blanks to be filled out relating to their previous courses of study.

They are required to furnish certificates from officers of the college or scientific schools where they have studied, as to the courses pursued in physics, chemistry and biology. If such certificates are satisfactory, no examination in these subjects will be required from those who possess a degree in arts or science from an approved college or scientific school.

Candidates who have not received a degree in arts or in science from an approved college or scientific school will be required (1) to pass, at the beginning of the session in October, the matriculation examination for admission to the college department of the Johns Hopkins University, (2) then to pass examinations equivalent to those taken by students completing the Chemical-Biological course which leads to the A. B. degree in this University, and (3) to furnish satisfactory certificates that they have had the requisite laboratory training as specified above. It is expected that only in very rare instances will applicants who do not possess a degree in arts or science be able to meet these requirements for admission.

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Since the opening of the Johns Hopkins Hospital in 1889, courses of instruction have been offered to graduates in medicine. The attendance upon these courses has steadily increased, and with each succeeding year to those given here, preceding that year of the course for admission to which application is made, have been satisfactorily completed, and (3) must pass examinations at the beginning of the session in October in all the subjects that have been already pursued by the class to which admission is sought. Certificates of standing elsewhere cannot be accepted in place of these examinations.

The completed organization of the Medical School, it was found necessary to give the courses intended especially for physicians at a later period of the academic year than that hitherto selected. It is, however, believed that the period now chosen for this purpose is more convenient for the majority of those desiring to take the courses than the former one. The special courses of instruction for graduates in medicine are now given annually during the months of May and June. During April there is a preliminary course in Normal Histology. These courses are in Pathology, Bacteriology, Clinical Microscopy, General Medicine, Surgery, Gynecology, Dermatology, Diseases of Children, Diseases of the Nervous System, Genito-Urinary Diseases, Laryngology and Rhinology, and Ophthalmology and Otolaryngology. The instruction is intended to meet the requirements of practitioners of medicine, and is almost wholly of a practical character. It includes laboratory courses, demonstrations, bedside teaching, and clinical instruction in the wards, dispensary, amphitheatre, and operating-rooms of the Hospital. These courses are open to those who have taken a medical degree and who give evidence satisfactory to the several instructors that they are prepared to profit by the opportunities here offered. The number of students who can be accommodated in some of the practical courses is necessarily limited. For these the places are assigned according to the date of application.

During October a select number of physicians will be admitted to a special class for the study of the important tropical diseases met with in this region.

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# BULLETIN

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## MORBID CONDITIONS CAUSED BY *BACILLUS AËROGENES CAPSULATUS*.

THE SHATTUCK LECTURE.

BY WILLIAM H. WELCH, M. D.,

*Professor of Pathology, Johns Hopkins University.*

### CONTENTS.

Introduction.—Historical.—Nomenclature.—Characters of *Bacillus*. Distribution.—Gas-Bubbles in the Blood and Organs.—Emphysematous Gangrene.—Gaseous Abscesses.—Uterine Infections; Emphysema of the fœtus; puerperal endometritis; physometra; emphysema of the uterine wall; puerperal gas-sepsis.—Infections of the Urinary Tract.—Infections derived from the Gastro-intestinal Canal: Local gastro-intestinal lesions; pneumo-peritonitis with and without perforation; hepatic and biliary infections.—Interstitial Emphysema of the Gastro-intestinal, Genito-urinary, and Biliary Tracts.—Pulmonary and Pleural Infections.—*Bacillus Aërogenes Capsulatus* in the Blood during Life.—Presence of *Bacillus Aërogenes Capsulatus* without Gas.—Meningitis and Pyogenic Capacity of *Bacillus Aërogenes Capsulatus*.—Cavities in the Brain.

Although the subject which I have chosen for this lecture relates for the most part to infrequent affections, the scientific and practical interest attaching to them is considerable and varied. Many instances of the presence of free gas in parts

of the body where it does not normally occur and in association with various diseases were recorded by writers of past centuries and were even then the subject of much speculation. The discussion turned generally around the question whether the gas was atmospheric air or the result of putrefaction—a question which in most cases could be solved only by bacteriological examinations. The most numerous and important of such examinations have been made during the last decade, and, although these have left problems still unsolved, they have corrected many current errors and have shed a flood of light upon conditions which were formerly among the most mysterious in pathology.

While it has been demonstrated that various bacteria may be concerned in producing gaseous affections, it is now evident that the bacillus which I discovered in 1891, and to which I gave the name *Bacillus aërogenes capsulatus*, is the one whose causative agency is best established and most frequently in action. What I shall say will relate mainly to this micro-organism and its pathogenic effects.

Delivered before the Massachusetts Medical Society, June 12, 1900.

*Historical.*—As a certain amount of confusion concerning

the dates of the first publications" on this bacillus exists in foreign literature on this subject, it may be well to state that I reported my observations in November, 1891, to the Johns Hopkins Hospital Medical Society and that the full report of these observations and of the characters of the bacillus was published in July-August, 1892, by Dr. Nuttall and myself.<sup>3</sup> E. Fraenkel's first publication<sup>4</sup> was a short preliminary one which appeared in January, 1893, and was followed in the same year by his valuable monograph on gaseous phlegmons.<sup>5</sup> In August, 1893, one year after the publication of the paper by Nuttall and myself, appeared simultaneously the interesting articles of P. Ernst<sup>6</sup> and of Graham, Steward and Baldwin<sup>7</sup> on foamy organs. Early in 1894 Mann published from my laboratory an observation of emphysematous gangrene caused by *Bacillus aërogenes capsulatus*,<sup>8</sup> and in January, 1896, Dr. Flexner and I published an extensive paper reporting twenty-three human cases, including not only six personal observations of emphysematous gangrene but also examples of submucous gas-cysts, pneumoserositis, and various other pathogenic manifestations of this bacillus.<sup>9</sup> In July, 1895, appeared Goebel's preliminary communication,<sup>10</sup> and in the following year his full paper on the bacillus of foamy organs.<sup>11</sup> Of the subsequent records the most numerous and valuable have appeared in this country, although they appear to be little known to most European writers.<sup>12</sup> I shall have occasion

to refer later to many of these publications, among which those of Dunham, Dobbin, Norris, Bloodgood, Howard, Nicholls, and Pratt and Fulton, may here be mentioned as especially valuable.

*Nomenclature.*—Dr. Fraenkel has kindly favored me with cultures of the bacillus which he isolated from gaseous phlegmons and to which he gave the name "*Bacillus phlegmones emphysematosæ*." There can be no question whatever but that his bacillus is identical with our *Bacillus aërogenes capsulatus*, a point upon which we are both agreed, and which is also made certain by Goebel's studies under Fraenkel's supervision. According to the generally accepted principles of the nomenclature of zoological and botanical species, the name "*Bacillus aërogenes capsulatus*," as being the first one applied, should be preferred to that of *Bacillus phlegmones emphysematosæ*. It is, moreover, as pointed out by Muscatello, not open to the objection of implying exclusive relationship to a single disease, as is the case with Fraenkel's designation of the bacillus. As a matter of fact, as we shall see, the capacity to produce gaseous phlegmons is only one of many pathogenic manifestations of *Bacillus aërogenes capsulatus*. Unfortunately I think that we both erred against the canons of botanical nomenclature in using a trinomial rather than a binomial name for a species.<sup>13</sup>

*Characters of Bacillus.*—Since our first publication only one material addition has been made to the extended description given by Welch and Nuttall of the morphological and cultural characters of *Bacillus aërogenes capsulatus* or the gas-bacillus as I shall briefly call it.<sup>14</sup> Fraenkel noted the presence of spores in a few of the bacilli growing in one lot of agar containing sodium formate, and in 1897 Dunham<sup>15</sup> observed spores, with all of the specimens studied, in blood-serum cultures, but not in other media.

Our further studies of the gas-bacillus obtained from different sources have shown a moderate range of variation in some of its properties. This is true especially of spore-formation, rapidity of liquefaction of gelatine, presence of capsules and virulence.

<sup>13</sup> Migula, who, with considerable success, has attempted to reform bacteriological nomenclature, has given the binomial names "*Bacterium Welchii*" to *Bacillus aërogenes capsulatus* and "*Bacterium emphysematosum*" to *Bacillus phlegmones emphysematosæ* (System der Bakterien, II, pp. 392 and 383, Jena, 1900). He is, however, in error in describing this organism under two different names, as his *Bacterium Welchii* and *Bacterium emphysematosum* are identical.

<sup>14</sup> As regards these characters it will suffice here to say that the microorganism is a rather coarse, non-motile, anaërobic bacillus; stains by Gram; grows on all of the ordinary culture-media under anaërobic conditions, best at body temperature, but also at room temperature; liquefies gelatine slowly; forms spores constantly according to the race and the culture-medium, and is capable of generating gas not only by fermentation of sugars but also from proteids. The full description of the characters may be found in Welch and Nuttall's paper.

<sup>15</sup> Bulletin of the Johns Hopkins Hospital, 1897, VIII, p. 68.

<sup>3</sup> Levy's description in 1891 (Deutsche Ztschr. f. Chirurg., XXXII) of "kleine, feine" bacilli, cultivated from a gaseous abscess and growing in long threads and chains only at body temperature and cultivable only in the first generation, without animal experiments, cannot be accepted as an identification of *B. aërog. capsulatus*, or indeed be readily reconciled with its characters.

<sup>4</sup> Bulletin of the Johns Hopkins Hospital, 1892, III, p. 81.

<sup>5</sup> Centralbl. f. Bakter., XIII, p. 13.

<sup>6</sup> Ueber Gasphegmonen. Hamburg u. Leipzig, 1893.

<sup>7</sup> Virchow's Archiv, CXXXIII, p. 308.

<sup>8</sup> Columbus Med. Journ., XII, p. 55.

<sup>9</sup> Annals of Surgery, XIX, p. 187.

<sup>10</sup> Journal of Experimental Medicine, 1896, I, p. 5.

<sup>11</sup> Centralbl. f. allg. Path. u. path. Anat., VI, p. 465.

<sup>12</sup> Jahrb. d. Hamburgischen Staatskrankenanstalten, IV.

<sup>13</sup> Thus v. Hibler in 1899 (Centralbl. f. Bakt., XXV, p. 513 et seq.), in an elaborate study of pathogenic anaërobes, is entirely ignorant of our work and that of other American investigators on *B. aërog. capsulatus*. The information of Hirschmann and Lindenthal (Sitzungsber. d. k. Akad. d. Wiss., Math.-Naturw. Cl., Wien, 1899, CVIII, Heft 3, Abth. III, p. 67) on the American work is secondhand and both incomplete and inaccurate, in these respects being in unfavorable contrast to that of Muscatello, assisted by Gangitano (Riforma Med., 1900, II, p. 508 et seq.), who write also on the subject of emphysematous gangrene. Knowledge of *Bacillus aërogenes capsulatus*, under the name "*Bacillus perfringens*" (Veillon and Zuber), has begun to appear in France in the last two years, but without evidence of acquaintance with the American publications. Even allowing for the great difficulties in keeping pace with the literature of any subject in medicine, a decade would certainly seem sufficient for the light to penetrate even into dark places.



While some specimens of the bacillus seem never to form spores on any culture-medium, others, and these appear to be the more common, do so occasionally, especially upon blood-serum, in mannite bouillon, and on plain agar. In animals inoculated with pure cultures we have not observed spore-bearing bacilli.

As a rule the bacillus liquefies gelatine slowly but some specimens do so scarcely at all, and others with fair rapidity. In our first communication we noted peptonization and softening of the gelatine, but this was so slow and slight with the particular specimen studied that we then preferred to class the bacillus among the non-liquefiers. Further experience has shown that the bacillus is a liquefier, but generally a slow one.

As stated in our original article, capsules are not constantly present, but I have generally found no difficulty in demonstrating them in the situations and by the method described by us, and, with the exception of Hirschmann and Lindenthal, most other investigators have been able to demonstrate capsules, when these are searched for by suitable methods.

While the bacillus is to be ranked among those which stain by Gram, it is sometimes rather noticeable in coverslips from cultures that among well stained bacilli, others are partly or wholly decolorized, and this may be observed in members of a single chain. In the tissues the bacilli stain well by Gram. Differences in the viability of cultures were pointed out in our first paper.

It sometimes happens that original cultures from human beings show only a feeble growth, with relatively weak power of gas-production, while subsequent cultures, especially those obtained after passage through the animal body, present the usual vigorous growth and other typical characters. Pratt and Fulton,<sup>18</sup> from a typical case of foamy organs with gas throughout the body, were unable to cultivate the bacillus at all, although twelve anaerobic culture tubes containing various media were inoculated from different parts of the body. This negative result they attribute to the fact that the body had lain in a cold storage vault for sixteen hours after death, an explanation which has some support in an observation previously reported by Welch and Flexner, but still seems hardly satisfactory, as under like conditions the bacillus has been often cultivated.

Lactose, glucose and saccharose are all fermented by the gas-bacillus, the first with the largest production of gas and the last with the smallest. The gas, according to Dunham's analyses, is composed approximately of 64 per cent hydrogen, 28 per cent carbon dioxide, and 8 per cent of a residual gas believed to be mainly nitrogen. It has no foul odor. The amount of hydrogen always greatly predominates over that of carbon dioxide. There is apparently no fermentation of mannite, at least the gas is not appreciably more than in sugar-free media.

E. Fraenkel in 1893 was the first to demonstrate the etiological relation of the gas-bacillus to gaseous phlegmons; our

previous investigations being concerned mainly with the so-called foamy organs (Schaumorgane) and the presence of gas in the blood, our results being confirmed a year later by P. Ernst. Soon after Fraenkel's publication we were able to confirm his discovery of the causation of gaseous phlegmons by *Bacillus aerogenes capsulatus*, and to repeat with like results his animal experiments.

Material or cultures fresh from the infected body are usually highly virulent for guinea-pigs, pigeons and sparrows (E. Fraenkel), which succumb to rapidly spreading local necrosis of the tissues with abundant development of gas, the bacilli invading the blood during life only in small numbers or not at all. There is more or less bloody edema, but otherwise little inflammatory reaction, leukocytes being present usually only in small numbers in the exudate. Rabbits and mice, while not wholly immune, are far less susceptible than guinea-pigs and pigeons. Dr. Lanier in my laboratory in 1896 succeeded in producing typical gaseous phlegmons around the fractured bones of rabbits inoculated intravenously with pure cultures, and Muscatello has obtained the same results. There are considerable differences in the degree of virulence of the bacillus even in fresh cultures, and old ones may be of very slight virulence.

One of the most interesting and valuable tests of the gas-bacillus is its power of producing gas abundantly in the blood, organs and tissues of rabbits killed a few minutes after intravenous injection, a power not possessed by colon bacilli. The differential value of this test is as great as that of cultures in fermentation tubes. The blood and tissues of the dead rabbit make the culture-medium, the body of the animal takes the place of the test tube, the inoculation is an aseptic one, the bacteria are spread by the blood-current and the conditions are anaerobic. This procedure, which was introduced by Nuttall and myself and has been fully described by us, we have found useful under proper precautions in isolating the gas-bacillus, in separating it from other bacteria which may resemble it, and in the demonstration of one of its most fundamental characteristics, namely, the power to produce gas from proteid material.

Among the points distinguishing the bacillus of malignant edema from *Bacillus aerogenes capsulatus* may be mentioned the following: The malignant edema bacillus is somewhat thinner; has greater tendency to grow into filaments; is less readily stained by Gram; produces spores regularly in culture-media; is motile; liquefies gelatine much more rapidly; produces a foul odor; generates less gas in lactose bouillon; clots and then peptonizes casein; generates little or no gas in rabbits inoculated intravenously and then killed; and by subcutaneous inoculation in susceptible animals causes spreading bloody edema with little or no development of gas-bubbles, and appears after death in filaments on serous surfaces.

The bacillus to which Lindenthal<sup>19</sup> has quite unnecessarily given the name *Bacillus emphysematis vaginae* is doubtless identical with *Bacillus aerogenes capsulatus*. The same is

<sup>18</sup> Boston Med. and Surg. Journ., June 7, 1900, p. 599.

<sup>19</sup> Wiener klin. Wochenschr., 1897, p. 3, et seq.

true of Veillon and Zuber's<sup>18</sup> *Bacillus perfringens* found by them in appendicitis, by Guillemot<sup>19</sup> in gaseous gangrene and by Soupault and Guillemot<sup>20</sup> in gaseous abscesses, and of Buday's<sup>21</sup> *Bacillus cadaveris butyricus*, and Cesaris-Demel's<sup>22</sup> bacillus, both found in foamy organs. I am strongly inclined to the opinion that the anaërobic bacillus isolated by Achalmé and others from the blood and tissues of several cases of acute articular rheumatism and found by Savtchenko and Mielkitch in the soil is likewise identical with our gas-bacillus.<sup>23</sup> As will be considered later, Gwyn has cultivated *Bacillus aërogenes capsulatus* also from the blood of a choreic patient during life.

*Distribution.*—The surmise expressed by Welch and Nuttall that the gas-bacillus is widely distributed in nature has since been confirmed. The natural habitat of the organism is the intestinal canal and the soil, the homes of so many other anaërobic bacteria. Welch and Flexner in 1896 brought evidence of the presence of the bacillus in both of the situations mentioned. Clopton of the Johns Hopkins Hospital has found the bacillus twice in the normal appendix vermiformis. Howard<sup>24</sup> has recently reported the presence of morphologically identical bacilli in the intestines of twenty-five consecutive human cases examined post mortem, and in ten of these he demonstrated the bacillus by cultures and inoculation of animals. The same conclusion concerning the regular presence of the bacillus in the intestine has been reached by Hirschmann and Lindenthal. The gas-bacillus has been repeatedly cultivated from the intestine in my laboratory, but we have made no systematic study of the frequency of its presence.<sup>25</sup> I have found the bacillus also in the intestines of rabbits, dogs and swine, and here it is interesting to note the frequency with which submucous gaseous blebs are found in the pig's intestine at autopsy.

In 1896 Dr. Walker, at the Johns Hopkins Hospital, succeeded in finding *Bacillus aërogenes capsulatus* in dust collected by sweeping floors, proving its presence both by cultures and animal experiments. My assistant, Dr. Harris, has cultivated the bacillus from the contents of an old cesspool. I had

previously reported in 1896 the isolation of the bacillus from a bullet removed from the head of the tibia in a case of gaseous phlegmon, and E. Fraenkel<sup>26</sup> has cultivated the gas-bacillus from a splinter of wood extracted from a wound in a case of tetanus. These observations confirm the natural inference to be drawn from the study of cases of traumatic emphysematous gangrene, in most of which the source of infection is manifestly foreign material, especially dirt, in wounds. In the light of these demonstrations of the wide distribution of the gas-bacillus in the outer world and in fæces, the conclusion is warranted that it must occasionally be present upon the human skin.

We are not informed whether there are differences in the regional distribution of the gas-bacillus. The fact that during the last decade a larger number of cases of emphysematous gangrene have been reported from Baltimore than from any other single locality is due probably to our interest in the subject and consequent search for cases. The bacillus has been found not only in America and Europe, but Dr. Flexner has brought reports of three infections with the gas-bacillus in Manila observed during a stay of three months.

#### GAS-BUBBLES IN THE BLOOD AND ORGANS.

We turn now to the consideration of the various conditions in which *Bacillus aërogenes capsulatus* has been found in human beings. We need not pause to consider the occasional presence of this bacillus in ordinary cadaveric decomposition, a circumstance sufficiently explicable by the occurrence of this organism in the healthy intestinal canal.

Of an entirely different nature are the cases in which gas-bubbles are found in the blood and organs within a few hours after death and without any trace of ordinary putrefaction. Such a condition has been recognized at autopsies as soon as one, two, three, five, eight hours after death. It may occur not only after death from gaseous phlegmon, when, however, it is by no means constant, but also after death from the most varied causes. It has been observed repeatedly in autopsies on pregnant and puerperal women, especially after death from abortion and acute sepsis. Cases reported by Cless,<sup>27</sup> Jürgensen,<sup>28</sup> Vachetta,<sup>27</sup> Dunin,<sup>28</sup> Vogel<sup>29</sup> and others as examples of entrance of air or gas into the circulation from gastric ulcers, typhoid or dysenteric ulcers, pulmonary tuberculosis, in septicæmia and various other diseases, find now their natural explanation in the invasion of gas-bacilli, instead of in the curious hypotheses propounded by the authors cited. In all probability, although I have had no opportunity to observe such a case, the free gas which has been repeatedly found in

<sup>18</sup> Arch. de méd. exp., 1898, X, p. 539.

<sup>19</sup> Compt. rend. Soc. de biol., 1898, 10. s., V, p. 1017.

<sup>20</sup> Bull. et mém. Soc. med. d. hôp. de Paris, 1900, 3. S., XVII, p. 216.

<sup>21</sup> Centralbl. f. Bakt., 1898, XXIV, p. 369.

<sup>22</sup> Giornale d. R. Accad. di med. di Torino, 1898, LXI, p. 256 and LXII, p. 190.

<sup>23</sup> Achalmé, Ann. de l'Inst. Pasteur, 1897, XI, p. 845; Pic and Lesieur, Journ. de phys. et de path. gén., 1899, I, p. 1007, and Savtchenko and Mielkitch, Arch. russes de path., 1899, VIII, p. 145.

<sup>24</sup> Contributions to the Science of Medicine dedicated by his pupils to William Henry Welch on the 25th Anniversary of his Doctorate, p. 461, Baltimore, 1900.

<sup>25</sup> Mr. Hirschberg is now engaged in my laboratory in a study of the distribution of the gas-bacillus in human and animal intestines and in the outer world and will report his observations later.

<sup>26</sup> Münch. med. Woch., 1899, Nos. 42 and 43.

<sup>27</sup> Luft im Blute, Stuttgart, 1854.

<sup>28</sup> Deutsches Arch. f. klin. Med., 1882, XXXI, p. 441, and 1887, XLI, p. 569.

<sup>29</sup> Sull' embolismo gazzoso per penetrazione d'aria nel sistema circolatorio, Pisa, 1880.

<sup>30</sup> Berliner klin. Woch., 1882, p. 11.

<sup>31</sup> Ibid., 1882, p. 187.

the blood-vessels and heart after deaths from chloroform is due likewise to the invasion of the gas-bacillus, and is not, as supposed by Hankel,<sup>50</sup> nitrogen derived from air pressed through the lungs into the pulmonary blood-vessels in violent expiratory movements with closed glottis.

There is every gradation from cases with a few bubbles of gas in the blood or tissues to those with extensive emphysema of the organs and tissues. The term "foamy organs" (*Schaumorgane* of the Germans) may be applied to the latter condition. The liver is the organ most frequently the seat of early and abundant development of gas, but there is no definite rule as to the distribution and amount of gas in different cases. The gas may be limited to the abdominal veins or to the pulmonary vessels or to one of the cardiac cavities, or be found only in the tissues at one place, especially near the stomach or intestine. It is more abundant in the veins than the arteries, and may be only in the former. As will be explained later the invasion in the majority of cases is from the intestine. That the gas-bubbles may be dislocated from their original position in liquid and soft material in the body is self-evident, but I have not found them unassociated with gas-bacilli.

Formerly this early presence of free gas in the heart and vessels, without evident post-mortem decomposition, was very generally explained by the assumption of entrance of air into the circulation, even when no portal of entry could be found.<sup>1</sup> The most extensive application of this explanation was made in the pregnant and puerperal cases. It is remarkable that the first case of this nature to be examined bacteriologically was that reported by me in 1891. In this and in nearly all subsequent similar cases with satisfactory bacteriological examination *Bacillus aerogenes capsulatus* was found.

The main questions which arise concerning the interpretation of these cases are whether the invasion of the bacilli and whether the development of the gas are ante-mortem or post-mortem phenomena.

Rabbits survive the introduction of large numbers of gas-bacilli directly into the circulation, unless there exists somewhere in the body necrotic or damaged tissue offering little or no vital resistance. If the animal be killed within a few minutes after the intravenous injection of the bacilli and kept in a warm place, there are abundant multiplication of the bacilli and large development of gas throughout the body within the space of six or eight hours; whereas if the bacilli be introduced at one point, as for example the right heart, of a rabbit just killed, it takes a much longer time, often twenty-four to forty-eight hours, for gas and bacilli to make their appearance at points far distant from the seat of inoculation. It seems justifiable to draw from these three groups of experiments, which have been fully reported by Welch and Nuttall, the conclusion that when bacilli and gas are found within a few hours after death widely distributed

in the body, the gas-bacilli have entered the circulation during life, but probably in most cases only shortly before death.

There is one factor, however, to be considered which is absent in the experimental cases and may be present in human beings, to wit, the quick disappearance of the bactericidal power of the blood. This factor is an important determinant of the rapidity of onset of post-mortem decomposition. Very soon after death from certain diseases, and particularly from snake-venom, bacteria may make their appearance in the blood and organs. An explanation of these cases is furnished by the experiments of Ewing and myself,<sup>51</sup> which demonstrated that the blood of rabbits killed by rattlesnake venom is practically devoid of bactericidal power, so that immediately after or even shortly before death bacteria can start growing in the body as they would in a tube of beef-broth. But after all due allowance has been made for the possible reduction or loss of bactericidal power of the blood, I still consider that it is not possible to explain some of the cases in which bacilli and gas have been found in the heart, blood-vessels and organs very soon after death, especially when the corpse has been kept in a cold place, otherwise than upon the assumption of the distribution of the bacilli by the circulating blood.

It is another question whether gas as well as bacilli may be present in the circulating blood and internal organs during life in the class of cases now under consideration, and I regret to be unable to furnish a positive answer to this question. I do not see how an affirmative answer can be obtained other wise than by the actual demonstration of gas in these situations either during life or immediately after death. Gas-bubbles and bacilli have been found in the heart and vessels within an hour after death, but that is time enough for bacilli which have already been introduced to multiply and begin to form gas. I at first thought that absence of nuclear staining around the gas-bubbles and masses of bacilli might serve as an indication of their presence during life, and this view is advocated by P. Ernst, but I have since learned from experiments on rabbits that this is not a decisive criterion, although often both in rabbits and in human beings there is no defect in nuclear staining around bacilli and gas-bubbles.

I know of no other pathogenic microorganism which offers such difficulties in determining whether its effects in the interior of the body have been produced before or after death. The difficulty arises from the circumstances that these effects in most cases and most situations consist almost entirely in local necrosis and formation of gas, whether the invasion and growth of the bacilli be before or after death, and that unlike most pathogenic bacteria the gas-bacillus grows better in the dead than the living body. Possibly some importance in the solution of the problem may attach to the demonstration of emboli of liver cells and of bone-marrow cells which were in enormous numbers in the pulmonary vessels in a case of gaseous phlegmon of the sub-mammmary tissues following infusion of salt-solution. At the autopsy made by Dr. Carroll

<sup>50</sup> Cless. *Luft im Blute*. Stuttgart, 1854, and Couty. *Thèse*. Paris, 1875.

<sup>51</sup> *Lancet*, 1894, I, p. 1236.



the liver and other organs were emphysematous. Further observations with reference to these emboli in this class of cases are needed.

I do not consider that there is any inherent improbability in the supposition that gas-bubbles may be in the circulating blood during life without causing speedy death from gaseous embolism. It is only when a large volume of air is introduced quickly into the blood-current that sudden death results from air-embolism. Very exaggerated ideas have prevailed among physicians as to the dangers from the entrance into the circulation of small quantities of air. Laborde and Murot<sup>22</sup> injected into the external jugular vein of a dog 1120 cc. of air in the space of one hour and a half without causing death, and Jürgensen,<sup>23</sup> into the left femoral artery of a narcotized dog weighing 13½ kilo, 3650 cc. in the space of two hours and twenty-five minutes with only slight disturbance of the respiration and of the action of the heart. Hare,<sup>24</sup> on the basis of experiments, likewise controverts current beliefs concerning the dangers from entrance of a moderate quantity of air into the veins.

I have come across in the older literature from the days when venesection was a common practice, reports of cases in which blood containing bubbles of gas escaped during venesection from veins of the arm.<sup>25</sup> In none of these was there evidence that air had gained entrance to the circulation. Maisonneuve,<sup>27</sup> in incising two gaseous phlegmons of the thigh following compound fracture, observed the escape of blood containing gas-bubbles from the cut veins and was able to trace the gas within the veins for a long distance.

It seems to me very improbable that an anaërobic bacillus, such as the gas-bacillus, can multiply in the circulating blood, still this bacillus is less sensitive to the presence of oxygen than many anaërobic, and we do not know whether the loose combination in which oxygen is present in the blood would necessarily prevent its growth under all circumstances.

I see no reason why this bacillus might not multiply and form gas in the liver, spleen and most other internal organs, as we know it can do in parts open to inspection during life. We have positive evidence in the cases reported by Graham, Steward and Baldwin and by Dunham that gas-bacilli may be conveyed by the circulation from an infected portal of entry—in the one case the puerperal uterus and in the other a urethral wound—to distant parts of the body and there produce subcutaneous emphysema and necrosis. There is no part of the body which offers such favorable conditions for the post-mortem growth of the bacillus as the liver, probably on account of its content of carbohydrate, and, if the liver like

the integuments were open to inspection during life, I believe that we should find evidence that in certain cases the emphysema of this organ, which is such a conspicuous post-mortem phenomenon in instances of invasion by the gas-bacillus, had begun during the life of the patient. As will be considered subsequently emphysema of mucous membranes open to inspection, we know can exist during life.

In the great majority of the instances, however, in which gas-bubbles are found in the blood and internal organs at autopsy the evidence is in support of the view that the development of the gas is a purely post-mortem phenomenon. Certainly the greatest caution should be exercised in the interpretation of any such cases as vital processes, even in early autopsies without ordinary putrefaction. One thing which our investigations have established is that the finding of gas-bubbles in the blood-vessels and heart within so short a time as one hour after death furnishes in itself no proof of the entrance of air into the circulation. Especially is it to be emphasized that the limitation of gas to the right heart and adjacent vessels may occur in cases of invasion by the gas-bacillus and is not, as is often represented, peculiar to air-embolism. I shall refer later to the question of gaseous embolism in cases of emphysematous gangrene and of physometra.

#### EMPHYSEMATOUS GANGRENE.

In a few instances we have found in wounds, usually compound fractures or gunshot injuries, in which dirt had gotten in, *Bacillus aerogenes capsulatus* without the presence of gas or other evidence that the bacillus was producing any characteristic effects.<sup>28</sup> Such cases have always been watched by the surgeons with anxiety, and it is probable that at least in some the early recognition of the bacillus followed by free incisions and thorough cleansing and disinfection has warded off a subsequent grave infection. In view of the wide distribution of the gas-bacillus in the outer world and in the intestinal contents it is probable that it must not so very infrequently gain access to wounds without securing a foothold. While this innocent behavior, with which we are also familiar in the case of the tetanus bacillus, may sometimes be due to attenuated virulence of the bacillus, it is probably oftener attributable to accessory circumstances, such as the resistance of the patient, the condition of the wound and surrounding tissues, and lack of association with suitable microorganisms and foreign substances.

It is as a cause of that most dreaded of wound complications, emphysematous gangrene, that *Bacillus aerogenes capsulatus* especially claims the interest of surgeons. The classical clinical descriptions of this disease we owe to Maisonneuve<sup>29</sup> and to Pirogoff,<sup>30</sup> the former giving to it the name

<sup>22</sup> Comptes rend. Soc. de la biol., 1873, V.

<sup>23</sup> Deutsches Arch. f. kl. Med., 1882, XXXI, p. 458.

<sup>24</sup> Therap. Gazette, 1889, 3. S., V, p. 606.

<sup>25</sup> Marshall's case reported by May, Trans. Path. Soc., London, 1858, IX, p. 157; Durand-Fardel's case also cited by May, and Pirogoff's case in his Grundzüge d. allgem. Kriegschirurgie, p. 1063, Leipzig, 1864.

<sup>27</sup> Cited from Hirschmann and Lindenthal, Sitzungsber. d. k. Akad. d. Wiss., Math.-Naturw. Cl., Wien, 1899, CVIII, iii, 3, p. 67.

<sup>28</sup> Such cases have been reported by Bloodgood from the Johns Hopkins Hospital in Progressive Medicine, 1899, IV, December, p. 158.

<sup>29</sup> Gaz. méd. de Paris, 1853, p. 592.

<sup>30</sup> Grundzüge d. allgem. Kriegschirurgie, pp. 867 and 1006, Leipzig, 1864.

"gangrène foudroyante," and the latter designating it "primary mephitic gangrene" or "acute gangrenous oedema." Among other more or less common designations are "emphysematous or gaseous gangrene," "gaseous phlegmon," "septic emphysema," "érysiplé bronzé" (Velpéau), "progressive gangrenous oedema," "gangrenous septicæmia," and "emphysematous cellulitis."

This wound complication was more common in preantiseptic times, especially in military surgery, than it is to-day, but at least 70 cases have been reported during the last quarter of a century. In prebacterial days the affection was attributed by some writers to the penetration of air into the tissues, but by most to the decomposition of the tissues, particularly of adipose tissue and bone-marrow, brought by an injury into contact with the atmosphere.

Bottini<sup>4</sup> in 1871 was the first to demonstrate the infective nature and transmissibility of emphysematous gangrene.

Later Gussenbauer<sup>5</sup> also recognized the disease as a definite infection and attributed it to the bacteria of putrefaction. After Pasteur's discovery in 1877 of his "vibron septique," more commonly, since Koch and Gaffky's investigations, designated *Bacillus oedematis maligni*, and especially after Chauveau and Arloing's<sup>6</sup> paper in 1884, cases of emphysematous gangrene have been usually reported, especially in France, as instances of Pasteur's gangrenous septicæmia or Koch's malignant oedema. W. Koch's<sup>7</sup> attempt to identify the disease with symptomatic anthrax (Rauschbrand) was based on faulty bacteriological studies and has met with no confirmation. In 1884 F. J. Rosenbach<sup>8</sup> reported finding in coverslip specimens from two cases of traumatic emphysematous gangrene coarse bacilli, some of which had terminal spores. These he was unable to cultivate, only aerobic methods being employed. It is probable that Rosenbach saw *Bacillus aerogenes capsulatus* in these cases, but without distinguishing it from associated spore-bearing bacilli.

A critical examination of the records of alleged malignant oedema in human beings shows that in very few was the organism concerned satisfactorily identified as the genuine malignant oedema bacillus. Very often it has been simply assumed without more than a microscopical examination that bacilli found in spreading oedematous conditions with or without gas have been those of malignant oedema, and even where cultures and animal experiments have been employed the descriptions are frequently so meagre as to leave the identity of the organism wholly in doubt. In France it is usually assumed without any discussion and even without any bacteriological examination that *gangrène foudroyante* is malignant oedema (Pasteur's septicæmia),<sup>9</sup> and the same ignorance

of the present status of this subject is still sometimes encountered in England, Germany and elsewhere. Nevertheless the investigations of the last seven years, beginning with those of E. Fraenkel and soon followed by observations of myself and collaborators, have demonstrated that by far the most common and important specific cause of gaseous phlegmons or emphysematous gangrene is *Bacillus aerogenes capsulatus*.

Whether the bacillus of malignant oedema can produce an identical or similar anatomical and clinical affection in human beings I regard as an unsettled question. It is certainly remarkable in view of current doctrines in text-books that neither E. Fraenkel nor I, with our relatively large experience, nor indeed, so far as I am aware, any one who has made himself thoroughly acquainted with *Bacillus aerogenes capsulatus*, has encountered an instance of emphysematous gangrene in man caused by the bacillus malignant oedema. The whole subject of human malignant oedema is one which needs thorough revision and investigation by more exact bacteriological methods than have yet been applied to it.<sup>10</sup> I have already mentioned the chief points of difference between the bacillus of malignant oedema and *Bacillus aerogenes capsulatus*.

There is a relatively small group of cases of gaseous phlegmon attributed by those reporting them<sup>11</sup> either to the colon bacillus or the proteus bacillus. In most of these cases anaerobic culture methods were not employed. No one has succeeded in producing experimentally gaseous phlegmon with either of these bacilli, and I think there is good reason to be skeptical concerning their capacity to produce this disease, unless perhaps *Bacillus coli* may do so in diabetics.

It is possible that some of those reporting the colon bacillus as the cause of emphysematous gangrene may have confounded with it a facultative anaerobic bacillus which we have isolated from two cases of this disease, and which has been studied in my laboratory by Dr. Lanier. It resembles in anaerobic cultures very closely *Bacillus aerogenes capsulatus*, but it is capable of aerobic growth also, and then the rods are thinner and more like colon bacilli. It has the power of producing gas abundantly in the blood and tissues of rabbits killed a few minutes after intravenous injection, a power not possessed by genuine colon bacilli. I have already spoken of

10. S., V, p. 1017) who has found *B. aerog. caps. (B. perfringens)* in a case of gaseous gangrene and who controverts the prevalent view of French authors who attribute this disease exclusively to Pasteur's vibrio.

<sup>11</sup> In the case reported recently by Brabec (Wiener klin. Rundschau, 1900, XIV, pp. 145 and 167) the identification of the malignant oedema bacillus seems satisfactory. Here there was extensive bloody oedema without gas, so that the case was not one of emphysematous gangrene. On the other hand, Hämig and Silberschmidt (Correspondenzbl. f. Schweizer Aerzte, 1900, XXX, p. 361) bring no proof of any consequence that they were dealing, as they supposed, with the malignant oedema bacillus in two cases of *gangrène foudroyante*.

<sup>12</sup> Chiari, v. Dungern, Bunge, Klemm, Hlava, Evans, Grasberger, Hauser, Margarucci, Muscatello, Hitschmann and Lindenthal.

<sup>4</sup> Gior. d. r. Accad. di med. di Torino, 1871, 3. S., X, pp. 1121 and 1138.

<sup>5</sup> Deutsche Chirurgie, Lief. 4, Stuttgart, 1882.

<sup>6</sup> Bull. Acad. de Méd., 1884, 2. S., XIII, p. 604.

<sup>7</sup> Deutsche Chirurgie, Lief. 9, Stuttgart, 1886.

<sup>8</sup> Die Mikroorganismen bei den Wund-Infektions-Krankheiten des Menschen, Wiesbaden, 1884.

<sup>9</sup> An exception is Guillemot (Compt. rend. Soc. de biol., 1898.

the importance of this test, which has been employed by none of the writers who have claimed to find colon bacilli as the cause of gaseous phlegmons. This bacillus, when virulent, is capable of causing the same spreading and fatal emphysematous necrosis in guinea-pigs and pigeons as is *Bacillus aerogenes capsulatus*.

I have been accustomed to speak of this bacillus, to which I have called attention in previous publications, as the aerobic variety of our gas-bacillus. I believe, however, that it is identical with Sanfelice's *Bacillus pseudo-oedematis maligni*,<sup>49</sup> with which he is inclined to identify Klein's "new bacillus of malignant oedema."<sup>50</sup> Chavigny<sup>51</sup> has isolated apparently the same bacillus, which he likewise identifies with Sanfelice's *Bacillus pseudo-oedematis maligni* (not to be confounded with the pseudo-oedema bacillus of Liborius), from a case of gaseous gangrene, and he also calls attention to the probability that others may have mistaken it for the colon bacillus. While, therefore, unwilling upon existing evidence to accept the colon bacillus as a demonstrated cause of gaseous gangrene (except perhaps in diabetics), I am of the opinion that an aerobic bacillus, probably identical with Sanfelice's *Bacillus pseudo-oedematis maligni*, is capable of producing this affection, but it is much less frequently concerned than *Bacillus aerogenes capsulatus*.

I have collected 46 cases of emphysematous gangrene, in all of which *Bacillus aerogenes capsulatus* was demonstrated, and, therefore, all reported or observed during the last seven years.<sup>52</sup> This is a far larger number of cases than has ever been brought together before.

<sup>49</sup> Ann. d. Istit. d'Igiene sper. d. Univ. di Roma, 1891, N. S., I, p. 365, and Ztschr. f. Hyg., 1893, XIV, p. 352.

<sup>50</sup> Centralbl. f. Bakter., 1891, X, p. 186.

<sup>51</sup> Ann. de l'Inst. Pasteur, 1897, XI, p. 860. Perhaps the bacillus found by Fôa and Bonome (Ztschr. f. Hyg., 1889, V, p. 403) in a case of anthrax-like septicæmia with gas in the tissues was Sanfelice's bacillus. Roncali in the Italian translation of Senn's Surgical Bacteriology (*Bacteriologia Chirurgica*, p. 109) also claims Sanfelice's bacillus as a cause of gaseous gangrene.

<sup>52</sup> This list includes 16 cases observed in Baltimore, mostly at the Johns Hopkins Hospital, of which 2 are unpublished, and the remaining 14 have been published by Mann (1), *Ann. Surg.*, 1894, XIX, p. 187; Welch and Flexner (6), *Journ. Exp. Med.*, 1896, I, p. 5; Martin (1), *University Bulletin*, 1896, I, No. 3, and Bloodgood (6), *Progressive Medicine*, 1899, IV, December, p. 158. The notes of an additional unpublished case observed in Manila have been given me by Dr. Flexner. There are also 3 unpublished cases for the records of which I am indebted to Dr. Carroll of Washington.

The references to the remaining 26 cases are as follows: E. Fraenkel (4), *Ueber Gasphegmonen*, Hamburg u. Leipzig, 1893; Passow (1), *Charité-Annalen*, 1895, XX, p. 275; Dunham (5), *Bulletin of the Johns Hopkins Hospital*, 1897, VIII, p. 68; Ferguson (1), *Trans. Indiana Med. Soc.*, 1897, p. 339; Erdmann (1), *Med. Record*, Feb. 5, 1898, p. 205; Le Boutillier (1), *Med. Record*, March 5, 1898, p. 353; Love and Cary (1), *Med. Record*, April 8, 1899; Norris (1), *Amer. Journ. Med. Sc.*, 1899, CXVII, p. 195; Hitschmann and Lindenthal (5), *Sitzungsber. d. k. Akad. d. Wiss., Math.-Naturw. Cl.*, Wien, 1899, CVIII, Hft. iii, Abth. iii, p. 67; Thorndike (2), *Boston Med. and Surg. Journ.*, June 7, 1900, p. 592; Muscatello with Gangitano (3), *Riforma med.*, 1900, II, pp. 508,

Thirty-two are reported by American observers and only 14 by foreign investigators. Of the former group of cases 16 were observed in Baltimore, most of the cultures having been studied in my laboratory; of the foreign group of cases all are reported from Germany, Austria, Italy and France, 4 by E. Fraenkel, 1 (not absolutely certain) by Passow, 5 by Hitschmann and Lindenthal, 3 by Muscatello assisted by Gangitano and 1 by Guillemot.<sup>53</sup>

Cases of gaseous phlegmon in which *Bacillus aerogenes capsulatus* was not demonstrated are not included, although many of these presented the same clinical characters and doubtless in some at least the gas-bacillus was the active agent. This is true especially of the cases of gangrène foudroyante, usually without satisfactory bacteriological examination, attributed by French writers to Pasteur's vibron septique. Gertler's<sup>54</sup> eight cases of gaseous phlegmon cannot be utilized for our purposes at all, as they are without any satisfactory bacteriological reports.

A complete analysis of these 46 cases would afford material more than sufficient to occupy this entire address, so that I shall be able to present here only some of the more important points.

Thirty-five of the patients were males, 10 females and of one the sex is not stated. The preponderance of males is to be explained by the fact that most of the cases were due to severe injuries. Robust workmen in the prime of life furnished the largest contingent of cases.

In 80 per cent of the cases one of the extremities was the seat of the emphysematous gangrene, the lower being affected a little over twice as often as the upper extremities. In several instances the emphysema extended from the thigh to the abdominal wall or from the arm to the subcutaneous tissues of the shoulder and chest. There were three examples of primary emphysematous phlegmon of the abdominal wall: of these one following removal of the appendix (Bloodgood), one from an unrecognized strangulated Littre's hernia (Martin), and one affecting the deep tissues of a nephrectomy wound (Muscatello). In all of these the infection is believed to have started from the intestine. In one of Dunham's cases there was emphysematous gangrene (originating in a prostatic abscess opening in the buttock) of the scrotum, penis, and anterior abdominal and thoracic subcutaneous tissues. In three instances (Carroll (2); Dobbin (1) reported by Bloodgood) the breast and submammary tissues were the primary

519 and 530; Guillemot (1), *Compt. rend. Soc. de biol.*, 1898, 10. S., V, p. 1017. A few other cases in which the gas-bacillus was found are not reported with sufficient detail to be available for analysis. It is safe to say that *B. aerog. caps.* has now been found in over 50 cases of gaseous gangrene.

<sup>53</sup> Soupault and Guillemot (*Bull. et mém. Soc. méd. d. hôp. de Paris*, 1900, 3. S., XVII, p. 216) have reported two gaseous abscesses following hypodermic injections, and a third which they regard as metastatic, in which they found the gas-bacillus (*B. perfringens*), once in pure culture. These cases will be considered subsequently under the heading "Gaseous Abscesses."

<sup>54</sup> *Ueber Gasphegmonen*. Inaug.-Diss. Halle, 1898.



seat of the disease, all of these resulting from the infusion of salt solution. In one case (Dunham) the gaseous phlegmon appeared at the angle of the lower jaw after incision of a foul submaxillary abscess. In one instance (Welch and Flexner) it started within the pelvis from traumatic rupture of the rectum and extended through the sciatic notch down the thigh.

Of especial interest are three examples of multiple or metastatic emphysematous gangrene, one of the forearm and opposite shoulder, another of the thigh and both shoulders, and still another of one shoulder and the buttocks. In the older literature are similar cases; thus Nélaton observed emphysema not only in the injured leg but also in the opposite, uninjured extremity. In 1897 Leech<sup>2</sup> reported without adequate bacteriological examination a case of emphysematous gangrene of the right leg following about three weeks after injury of the right thumb, which became inflamed, there being no evident local cause of the affection of the leg. These cases are to be explained by transportation of the bacilli through the lymphatic or blood-current from the primary focus of entrance.

In all but 5 of the 46 cases the emphysematous gangrene followed traumatism or a surgical operation. The injuries were as follows: compound fractures, 18; bullet and gunshot wounds, 7; infusion of salt solution, 3; hypodermic injections, 2; ligation of the femoral artery for aneurysm, 3; external urethrotomy, 2; traumatic rupture of the rectum, removal of the appendix, prostatic abscess following self-catheterization, operation for strangulated, Littre's hernia, incision of a foul submaxillary abscess, and nephrectomy, each 1. Of the 5 non-traumatic cases the gaseous gangrene followed erysipelas in one, was consecutive to apparently spontaneous gangrene in 2, whether diabetic or not is not stated, and was without apparent explanation in two (Fraenkel's Case 2 and Passow).

Compound fractures and next bullet and gunshot wounds occupy by far the most prominent place in this list, each of the other various causes being represented only by scattered cases. Those injuries in which there are much laceration and crushing of tissue, comminution of bone and grinding of dirt, bits of clothing or other foreign bodies into the wound are the ones most likely to be followed by emphysematous gangrene. That, however, severe traumatism is not an essential factor is shown by the 5 cases (10.9 per cent of the entire number) following hypodermic injections and infusion of normal salt solution (see cases also under "Gaseous Abscesses.") These latter, however, were all of patients whose vital forces were greatly depressed, namely, by Asiatic cholera, typhoid fever, surgical shock, or post-partum hæmorrhage. There is good reason to believe that the intact tissues of human beings in health possess marked resistance to the gas bacillus.

In the great majority of cases it was evident that the gas bacillus was introduced through the wounded skin from without. In three instances (removal of appendix, strangulated

hernia, and traumatic rupture of the rectum) the infection undoubtedly came from the intestine. This was also the probable source of infection in one of Muscatello's cases (gaseous phlegmon in the site of an extirpated kidney). With our present knowledge of the frequent, if not regular, presence of *Bacillus aerogenes capsulatus* in the intestine, there is nothing surprising in this mode of infection. In three of Dunham's cases the infection followed injury of the urethra, and here also the bacilli may have come primarily from the intestine. In one of his cases (gaseous phlegmon at angle of the jaw) it was suggested that the bacilli gained entrance through decayed teeth.

Bloodgood thinks it probable that in one of his cases the gas-bacilli were brought by the circulation to the seat of infection. In this case the femoral artery was ligated for traumatic arterio-venous aneurysm in the popliteal space. There was no primary infection of the wound, but gangrene of the foot and leg ensued and on incision gas-bubbles were found in the blood of the aneurysmal sac and the tissues. With what we know about the entrance of intestinal bacteria into the circulation, there is nothing improbable in Bloodgood's opinion, which is also supported by Lanier's and Muscatello's experiments already mentioned. The clot in an aneurysm and tissues robbed of their nutrient supply would offer little or no resistance to the growth of bacilli which might reach them or their immediate neighborhood through the circulation and the conditions would be anaërobic. It was indeed a case of aneurysm in which I first found the gas-bacillus, and here the clot was swarming with bacilli. It is interesting to note that three of the cases of emphysematous gangrene in my list followed ligation of the femoral or popliteal artery for aneurysm.

Pirogoff<sup>3</sup> distinguished clinically two groups of cases of traumatic emphysematous gangrene. He described under the name "primary mephitic gangrene" cases in which the emphysema appears within two days after the injury, the "local stupor" passing without inflammatory reaction into crepitating gangrene. Here the emphysematous necrosis spreads rapidly, the patient sinks into collapse with an icteroid hue of the skin, small, thready pulse and cold sweats, and death occurs usually within a few days after the onset. This type of the disease corresponds to Maisonneuve's *gangrène foudroyante*. In the second group, designated by Pirogoff also as "acute gangrenous œdema," there is reaction from the primary "local stupor" of the tissues, the emphysema is preceded and accompanied by local, œdematous or purulent inflammation, is associated with febrile reaction, often appears later after the injury and spreads less rapidly, and presents in general a more varied anatomical and clinical picture than the first class of cases.

Hitschmann and Lindenthal consider that Pirogoff's first group corresponds especially to cases of pure or predominant infection with the gas-bacillus, and his second group to mixed infections. Edmann is also of the opinion that in the un-

<sup>2</sup> Quart. Med. Journ. (Sheffield), 1896-97, V, p. 237.

<sup>3</sup> Grundzüge d. allg. Kriegschirurgie, p. 1006, Leipzig, 1864.

mixed infections the emphysematous necrosis spreads more rapidly and is more likely to terminate fatally. On the other hand, Muscatello and Gangitano, who also divide the cases into two groups—pure infections and mixed infections—hold that the mixed infections are characterized by the rapidly progressive form of emphysematous gangrene, while the pure infections, at least in their early stage, show little tendency to spread beyond the injured tissues. According to the last named authors the gas-bacillus is incapable of exerting any pathogenic action upon healthy tissues, but attacks only tissues already altered in their vitality by injury, other pathogenic microorganisms, toxins, or other depressing factors.

The study of our cases has not enabled me to adopt in their exclusive form either of the two conflicting opinions just stated. Of the collected 46 cases, 30 were mixed infections, 14 were pure and of 2 there is no clear statement on this point. The most common associated bacteria were the pyogenic streptococci and staphylococci. Among other forms found occasionally were *Bacillus coli*, *proteus*, *pyocyanus*, tetanus, Sanfelice's *Bacillus pseudo-œdematis maligni*, and uncultivable, often spore-bearing, bacilli. It seems probable that the bacillus of malignant œdema, being a common inhabitant of the soil, must occasionally, like the tetanus bacillus, be present, but it was not isolated from any of these cases. My experience is that if reliance be not placed exclusively upon cultures, but careful microscopical examinations be also made, instances of unmixed infection with *Bacillus aërogenes capsulatus* are rare. It is by no means always easy to determine whether associated bacteria are exerting pathogenic action or not. Pyogenic cocci may be present without producing pus or marked inflammatory reaction.

We have found rapidly progressive forms of emphysematous gangrene both with pure infection with the gas-bacillus and with mixed infections, and on the other hand we have observed with both types of infection cases in which the tendency to spread is much less marked. In all of the cases with much purulent inflammation mixed infection was present, but aside from this feature the division of the cases into pure and mixed infections does not, according to our experience, correspond to different, sharply marked, clinical features. Pirogoff's classification is doubtless of clinical value, but there is every gradation between the two groups.

I cannot agree with Muscatello and Gangitano, whose investigations of emphysematous gangrene are of great value, that the gas-bacillus is incapable of attacking healthy tissues. Virulent cultures, even in moderate doses, can produce rapidly spreading gaseous phlegmons when inoculated into the subcutaneous tissues of susceptible animals such as guinea-pigs and pigeons. In human beings the emphysema may extend very rapidly into the healthy tissues, frequently outstripping in its advance the inflammatory œdema. This may occur in pure, as well as in mixed, infections with the gas-bacillus. After amputation through apparently healthy tissues there may be rapidly spreading emphysema from the stump (Welch and Flexner's Case II). The two instances of men-

ingitis observed by Hitschmann and Lindenthal and by Howard speak also for the power of the gas-bacillus to attack healthy tissues. It is true, as urged by Muscatello and Gangitano, that toxins derived from the bacilli may prepare the tissues for the invasion and action of the advancing bacilli, but the same explanation has been put forward for the spread of other pathogenic bacteria in healthy tissues. In asserting that the gas-bacillus may attack healthy tissues, I would not be understood as minimizing the great importance of the various accessory causes of emphysematous gangrene which act by lowering the vitality of the tissues or the general resistance of the patient, or as failing to recognize the marked resistance to infection by the gas-bacillus offered by the healthy tissues, a resistance to which I have previously called attention and which I shall have occasion further to emphasize.

Gas may appear in the tissues as early as eight hours after the injury. In a case of gaseous phlegmon following a bullet wound of the knee joint, reported by Welch and Flexner, Dr. Bloodgood recognized gas in the joint "and surrounding tissues just twenty hours after the injury. In a case of Dr. Tiffany's, which we have reported, death from emphysematous gangrene, due to pure infection with the gas-bacillus, occurred forty-eight hours after a fall causing a compound, comminuted fracture of the patella with grinding of the underclothing into the wound. There was no other injury of the body. Any one who has seen one of these rapidly fatal cases of spreading, traumatic, emphysematous gangrene will receive an impression which he will never forget.

The anatomical and clinical study of uncomplicated emphysematous gangrene demonstrates that the disease is not, as many formerly supposed, simply an intense variety of ordinary phlegmonous inflammation or cellulitis, but is a disease sui generis. It may be combined with phlegmonous inflammation, but then some other microorganism, usually the streptococcus, is associated with the gas-bacillus.

In typical uncomplicated cases the lesions consist in necrosis of all the tissues, the presence of gas in the interstices, infiltration with blood, evidences of the mechanical action of the gas, and exudation of a variable amount of bloody serum. The amount of gas varies much in different cases. There may be only a few bubbles or the tissues may be everywhere blown up with gas. The nuclei disappear by karyolysis. The notable thing in most cases is a nearly complete absence of leukocytes and of cellular reaction, although in a few instances, even of pure infection, I have found leukocytes in considerable number, and even purulent foci, but generally at a distance from the primary necrosis. As will be shown later *Bacillus aërogenes capsulatus* in certain situations is capable of setting up purulent inflammation. In one of our cases, reported by Bloodgood, Dr. Cushing found gas-bacilli without gas in a small subcutaneous abscess of a stump two

"It is to be regretted that in the cases reported by Prutz (*Deutsche Zeitschr. f. Chirurg.*, 1898, XLVII, p. 591), as traumatic entrance of air into the knee joint, no bacteriological examination was made.



months after amputation of the thigh for emphysematous gangrene of the leg, the amputation having been followed by uninterrupted convalescence.

After death there may be rapid extension of the subcutaneous emphysema, and at autopsies made a few hours after death gas-bubbles may be found in the heart, vessels, liver and other organs, but as to this occurrence there is no rule. As I have already explained wide-spread distribution of gas in the blood and organs in early autopsies indicates entrance of the bacilli into the circulation during life.

As is to be expected from the etiology of many of the cases of emphysematous gangrene, emboli of fat and of bone-marrow cells are common in the pulmonary capillaries, but I do not know that in any case they contributed to the fatal result.

The prognosis of emphysematous gangrene is more favorable to-day than before the antiseptic period. The disease terminated fatally in 59 per cent of the cases in my list. In the cases observed and treated at the Johns Hopkins Hospital—10 in number—the fatality was 50 per cent, but of these one was a gaseous phlegmon of the pelvis extending to the thigh, resulting from traumatic rupture of the rectum, a second was a gaseous phlegmon of the abdominal wall following removal of the appendix and complicated with diffuse gangrenous peritonitis, and a third case terminated twenty-five days after disappearance of a gaseous phlegmon of the thigh (treated by incisions) from a late streptococcus infection, gas and the gas-bacillus having disappeared. Of the two remaining fatal cases in one—emphysematous gangrene following compound fracture of the thigh—amputation was refused by the patient until the fourth day when he was in a state of collapse and died fifteen hours later, and in the other—compound fracture of the skull and both lower extremities—the patient died thirty hours after the accident, having never regained consciousness.

When the disease is accessible to surgical treatment, is not complicated by other grave conditions, and is promptly recognized and treated, the prognosis, according to the experience of my surgical colleagues, Professor Halsted and Dr. Bloodgood, is not very unfavorable.

The clinical evidence favors the view that, at least in most uncomplicated fatal cases, death is due to toxæmia. Norris was unable to demonstrate the presence of strong toxins in artificial cultures of *Bacillus aerogenes capsulatus*, but, as is well known, the same difficulty is encountered with many other pathogenic bacteria which are believed to produce poisons in the human body. Muscatello is also of the opinion that the constitutional symptoms are attributable to toxæmia.

The suggestion that death may be due to gaseous embolism is not new. Pirogoff and other of the older observers knew that gas-bubbles may be found within the heart and vessels very soon after the death of patients from emphysematous gangrene. In the discussion on Langenbeck's paper on traumatic infiltration before the Society of German Military Surgeons in 1870, Senator<sup>54</sup> advocated the supposition that death

is caused by gas-embolism. While the possibility of this occurrence as the cause of death may be admitted, there is at present no proof of this opinion. Gas-bubbles are by no means always found in the blood and organs after death from emphysematous gangrene, and the clinical histories of those in whom they are found post mortem do not appear to differ from those where they are absent. In experimental gaseous phlegmons in guinea-pigs there is no evidence of the presence of gas-bubbles in the circulation during life.

In one of our cases (Mann) death resulted from tetanus and Verneuil<sup>55</sup> has reported three cases which without bacteriological examination he, in conformity with current French opinion, calls malignant œdema, where also tetanus intervened. There is nothing surprising in this association when one considers that the home of the tetanus bacillus, like that of the gas-bacillus, is the soil. The period of incubation for tetanus is longer than for infection with the gas-bacillus, the former appearing rarely before the seventh day, and the latter usually within two or three days after the injury.

Prophylactic measures against emphysematous gangrene are sufficiently obvious from the etiological factors which have already been considered. It is important in wounds of the character most frequently followed by this complication to search microscopically and by cultures for *Bacillus aerogenes capsulatus*. The examination of coverslips, stained by Gram, will usually suffice for a probable diagnosis. I have already cited instances in which this bacillus has been detected before the onset of emphysema and in which there is good reason to think prompt surgical treatment warded off severe infection. The possibility of infection from the intestinal canal, as well as from external sources, is to be borne in mind.

The cases were treated either by free incisions or by amputation or both. The results were better after amputation than after simple incisions. Of the cases of emphysematous gangrene affecting primarily the extremities, the recoveries numbered 68 per cent after amputation, and 33½ per cent after incision without amputation. Careful study of individual cases shows that amputation is by no means always necessary. Everything depends upon early recognition of the nature of the infection. Dr. Bloodgood,<sup>56</sup> from a relatively large experience, says: "If the infection is recognized early, and the destruction of the soft parts and bone is not extensive, free incisions with immediate continuous bath treatment should be tried. If the general symptoms of infection are not immediately relieved, amputation should be done. If, however, the infection is recognized late one should take no risk but amputate at once. . . . An early diagnosis will probably save life, and from many observations an amputation may not always be necessary."

A similar position as to prognosis and treatment is taken by Muscatello and Gangitano in their valuable paper on gaseous

<sup>54</sup> *Semaine méd.*, 1890, p. 403.

<sup>55</sup> *Progressive Medicine*, 1899, IV, December, p. 174.

<sup>56</sup> *Deutsche militärärztl. Zeitschr.*, 1872, I, p. 260.



gangrene, in which they also emphasize the value of abundant irrigations with disinfectant and oxidizing solutions. In the service of Dr. Halsted at the Johns Hopkins Hospital the continuous bath treatment has been found useful. Hitschmann and Lindenthal are certainly mistaken in their assertion that incisions are usually without favorable effect and that early amputations offer the only chance of recovery. As pointed out by Thorndike and others recovery may follow amputation even when it is impossible to remove the whole of the diseased tissues.

#### GASEOUS ABSCESSES.

The presence of gas in closed abscesses may be due to *Bacillus aerogenes capsulatus*.

It seems to me questionable whether Fraenkel's<sup>1</sup> second case should be classified under emphysematous gangrene. In the region of the right elbow joint there was a painful fluctuating swelling from which on incision fetid pus mixed with gas-bubbles escaped. The subcutaneous tissue was partly necrotic. A similar swelling over the left shoulder joint was also incised. Besides the gas-bacillus, streptococci and long delicate bacilli appeared in the cultures. There is no statement concerning the causation of these abscesses. Passow's case was also a peculiar one. Following a superficial, suppurating wound of the right hand there appeared panophthalmitis with septicæmia, during which a crepitating swelling of the right shoulder and upper arm developed, from which on incision were evacuated gas and a brownish, fetid secretion, but no actual pus. Besides staphylococci a bacillus, believed by Passow to be identical with the gas-bacillus, was cultivated. I have included these two cases under the gaseous phlegmon or emphysematous gangrene, although at least the former seems to have been one of definite abscesses.

Soupault and Guillemot<sup>2</sup> have recorded two cases of gaseous abscess, following hypodermic injections, due to the gas-bacillus. They call the organism "*Bacillus perfringens*" (Veillon and Zuber), but identify it with Fraenkel's *Bacillus phlegmones emphysematosæ*. Of the American work on *Bacillus aerogenes capsulatus* they have apparently never heard. In Soupault and Guillemot's first case a large abscess containing fetid pus and gas with the odor of sulphuretted hydrogen followed the injection of 10 cc. of 5 per cent common salt solution into the thigh of a patient with advanced and rapidly extending pulmonary tuberculosis. The injection, made September 7, was at once followed by a painful swelling of the thigh, over which the skin was reddened; on September 15, gas was detected; on September 25, 300 cc. of chocolate-colored, thick, viscid pus mixed with gas were aspirated, and 8 days later an incision, from which 200 cc. of reddish pus escaped, was made, after which the abscess slowly healed. Aërobic cultures were negative; in anaërobic cultures *Bacillus aerogenes capsulatus* (Veillon and Zuber's *Bacillus perfrin-*

gens) was obtained in pure culture. From the foul odor of the pus and gas, which is said to have been distinctly that of sulphuretted hydrogen, it is probable that, at least at some stage of the process, other microorganisms were associated with the gas-bacillus, which survived for nearly a month in the abscess.

The same authors report a second case of gaseous abscess, which in this instance followed the injection of artificial serum into the abdominal walls of a child with grave typhoid fever. The abscess, which was opened by thermo-cautery, contained yellowish, viscid, inodorous pus. Three aërobic organisms, of which *Staphylococcus aureus* predominated, were found associated with *Bacillus aerogenes capsulatus*.

Soupault and Guillemot describe a third case of a young man, 19 years old, in whom a gangrenous phlegmon with extensive sloughing followed an injury of the left leg received in playing foot-ball. After the critical condition seemed to have passed, an emphysematous subcutaneous swelling appeared in the opposite, healthy leg near the inside of the knee. A hypodermic injection of salt solution had been made in the external part of the right thigh, but the authors do not consider that this had anything to do with the gaseous swelling, as the latter was too remote from the site of injection. They, therefore, attribute the gaseous phlegmon to transportation of bacilli by the circulation from the opposite extremity. *Bacillus aerogenes capsulatus* was found in pure culture. Recovery was uninterrupted.

Soupault and Guillemot emphasize the benign course of the affection in their three cases, as well as in other instances of gaseous abscess following hypodermic injections which they cite from published records. Conditions favoring the occurrence of such abscesses after these injections are the irritating quality of the fluids injected (ether, tincture of musk, camphor, acid solutions of morphine, concentrated saline solutions, etc.) and lowered general resistance of the patient produced by typhoid fever, tuberculosis, cancer, cholera, hæmorrhages, and other grave diseases. When death occurs, they think that it is usually attributable to the primary disease, not to the infection with the gas-bacillus.

I have included in my statistics of emphysematous gangrene 5 cases of gaseous phlegmon following hypodermic injections, 3 of these (Carroll 2, Dobbin 1) being of normal salt solution in puerperal women, and 2 (E. Fraenkel) being respectively of oil of camphor followed at once by ether in a patient after extirpation of a pyloric cancer, and of a solution in water of sulphuric acid and muriate of morphia in cholera. That the most unirritating of solutions may be followed by gaseous phlegmon is demonstrated by the three cases in which physiological salt solution was injected. Of these latter two died, and one recovered after incision of the phlegmon. Both of Fraenkel's cases terminated fatally.

Including Soupault and Guillemot's 3 instances of gaseous abscess we have altogether 8 cases of gaseous abscess or phlegmon following hypodermic injections of various substances, and caused by *Bacillus aerogenes capsulatus*, usually in association with other bacteria.

<sup>1</sup> Ueber Gasphegmonen, p. 15, Hamburg and Leipzig, 1893.

<sup>2</sup> Bull. et mém. Soc. méd. d. hôp. de Paris, 1900, 3. S., XVII, p. 216.

Brieger and Ehrlich's<sup>43</sup> two observations of fatal gaseous phlegmon following the hypodermic injection of tincture of musk in typhoid fever are usually cited as the first instances of authenticated malignant oedema in man, but it cannot be said that the bacillus concerned was proven beyond doubt to be that of malignant oedema, and with our present knowledge of the etiology of this class of affections it is permissible to question the accuracy of the identification of the bacillus in these two cases, notwithstanding the high authority of the observers. In the case of gaseous abscess following the intramuscular injection of ether reported by Bucquet,<sup>44</sup> and in the two similar cases reported by Lauteret,<sup>45</sup> all three ending in recovery, no bacteriological examination was made.

It is evident from the foregoing cases that *Bacillus aerogenes capsulatus*, in combination usually with pyogenic bacteria, is the chief, if not sole, cause of the gaseous abscesses or emphysematous gangrene which occasionally follow hypodermic injections. Although in none of the cases reported has this bacillus been looked for in the fluids injected, the presumption is that it was present either in them or in the syringe, although there is a possibility of the introduction of this organism from the skin of the patients, and even of its conveyance by the circulation from the intestine to the site of tissues damaged by the injection of irritating substances.

I shall refer subsequently to the occurrence of the gas-bacillus in abscesses without gas and to other manifestations of its pyogenic capacity.

#### UTERINE INFECTIONS.

Knowledge of *Bacillus aerogenes capsulatus* is of not less interest and importance to the obstetrician than to the surgeon. Infection of the puerperal uterus by this microorganism leads to a variety of morbid conditions, some comparatively mild, others of the utmost gravity.

The wide distribution of the gas-bacillus in the intestinal canal and the outer world renders as explicable the occasional presence of this bacillus in the female genital tract as that of the colon bacillus in the same situation. Lindenthal<sup>46</sup> found the gas-bacillus in the vagina without the presence of gas or other pathogenic effects twice out of six puerperal cases examined. According to the observations of others, Lindenthal's experience would seem to be exceptional. As with so many other pathogenic bacteria the mere presence of the organism upon exposed surfaces does not necessarily signify infection.

I shall consider the uterine infections by the gas-bacillus under the headings of emphysema of the fetus, puerperal endometritis, phymetra, emphysema of the uterine wall, and puerperal gas-sepsis, although these conditions may be associated with each other.

*Emphysema of the Fetus.*—The occurrence of emphysema

in the dead fetus in utero has been known for centuries,<sup>47</sup> but it was not until 1897, when Dobbin published his paper on "Puerperal Sepsis due to Infection with the *Bacillus aerogenes capsulatus*"<sup>48</sup> that the cause of this condition was determined to be invasion by *Bacillus aerogenes capsulatus*. In this case gas and the gas-bacillus were both recognized during the life of the patient in the fetus, the placenta and the cavity of the uterus, and after death there was general gas-formation throughout the body.

Dr. Dobbin has kindly given me the notes of a second, unpublished case observed by him. He was called to see a woman in difficult labor, upon whom repeated attempts at delivery of a dead fetus had been made. Upon examination he recognized crepitation of the caput succedaneum while the fetus was still in utero. Upon delivery the fetus was emphysematous with foamy organs. The gas bacillus was found in pure culture in the fetus and mixed with other bacteria in the amniotic fluid. No gas was recognized in the uterus after delivery. The patient made a good recovery without evidence of sepsis.

Menge and Krönig<sup>49</sup> have observed three instances of foetal infection by the gas-bacillus and have brought strong evidence that usually the invasion is through the mouth of the fetus, the bacilli being taken into the lungs or stomach by inspiring or swallowing amniotic fluid. In their cases the bacilli were not found in the part of the umbilical cord attached to the placenta, but in Dobbin's first case this as well as the placenta itself was infected with the gas-bacillus. The amniotic fluid within the intact membranes, as is well known, is usually sterile, and only exceptionally becomes infected before rupture of the membranes, so that the infection of the fetus from this source is generally after this rupture. As shown by Menge and Krönig, all grades of invasion of the fetus by the gas-bacillus occur, so that there may be only a small amount of gas, and this limited to the lungs or the alimentary canal or both. The medico-legal importance of not mistaking for air this gas in the foetal lungs produced by gas-bacilli should be emphasized.

As is well known, foetal emphysema is usually unattended with danger to the mother. In two of the five cases due to *Bacillus aerogenes capsulatus* in my list the puerperium was even without rise of temperature, in two there was mild fever, but in Dobbin's first case there was rapidly fatal gas-sepsis.

will be considered cases of acute uterine infection with the

*Puerperal Endometritis.*—Under the heading "gas-sepsis"

<sup>47</sup> It is usually stated that this condition was known to Celsus, but he does not expressly mention the presence of gas, although this is to be inferred. In the chapter on extraction of the dead fetus, he says: "Solet etiam evenire, ut is infans humore distendatur, exque eo profuatur foedi odoris sanies." Milligan's "Celsus," p. 394, Edinburgh, 1831.

<sup>48</sup> Bulletin of the Johns Hopkins Hospital, 1897, VIII, p. 24.

<sup>49</sup> Bakteriologie des weibl. Genitalkanals, Teil II, p. 167, Leipzig, 1897.

<sup>43</sup> Berliner klin. Woch., 1882, XIX, p. 661.

<sup>44</sup> Thèse, Paris, 1883.

<sup>45</sup> Thèse, Paris, 1898.

<sup>46</sup> Wiener klin. Wochenschr., 1897, pp. 3 and 35.

gas-bacillus followed by invasion of the blood and organs by this organism. Here it may be mentioned that *Bacillus aërogenes capsulatus* may be present in the uterus, usually in association with other bacteria, in both mild and severe cases of puerperal endometritis without the recognition of gas in the fetus, or the uterine cavity, or wall. An example of such a case is an unpublished one in the service of Dr. J. Whitridge Williams, of which the notes have been furnished me by Dr. Dobbin. A woman with rachitic pelvis, upon whom delivery by forceps had been attempted before admission to the Johns Hopkins Hospital, was there delivered by craniotomy. There was no gas in the fetus. Forty-eight hours later *Bacillus aërogenes capsulatus*, together with streptococci, was found in the uterine lochia. No gas was detected. The patient developed fever, but recovered.

In two cases, one reported by Dobbin<sup>16</sup> and the other by Blumer,<sup>17</sup> the gas-bacillus, although not identified with absolute certainty, was probably present in the puerperal uterus in association with the typhoid bacillus.

*Physometra*.—Distension of the uterine cavity with gas (physometra or tympany of the uterus) was present in Dobbin's first case, already cited, and is often associated with emphysema of the dead fetus, but may occur without the latter and even in the non-pregnant uterus. This curious condition was formerly ascribed to entrance of air or to ordinary putrefaction,<sup>18</sup> but it is now known to be the result of the activity of gas-producing bacilli.

Since the observations of Lindenthal,<sup>19</sup> reported in 1898, it cannot be doubted that *Bacillus aërogenes capsulatus* is the chief cause of physometra. He found this bacillus in five cases during life and reproduced the condition experimentally in guinea-pigs. He is justly skeptical of the correctness of the previous reports of Gebhard<sup>20</sup> concerning the agency of the colon bacillus in generating gas within the uterus. We know from Theobald Smith's investigations that the colon bacillus can produce gas only from carbohydrates, whereas it is the most distinctive biological attribute of our gas-bacillus that it can produce gas from proteids. Until it has been shown that the amniotic fluid and uterine contents may under any conditions contain enough carbohydrate to explain the development of gas by the colon bacillus there is every reason to question the claims for this bacillus as a cause of tympany of the uterus.<sup>21</sup>

My list of cases contains 10 instances of physometra in

<sup>16</sup> Am. Journ. Obstetrics, 1898, XXXVIII, p. 185.

<sup>17</sup> Ibid., 1899, XXXIX, p. 42.

<sup>18</sup> The older hypotheses and records on physometra and emphysema of the fetus are fully presented by Staude, Zeitschr. f. Geb. u. Gynäk., 1878, III, p. 191.

<sup>19</sup> Monatsschr. f. Geb. u. Gynäk., 1898, VII, p. 269.

<sup>20</sup> Zeitschr. f. Geb. u. Gynäk., 1893, XXVI, p. 480, and 1897, XXXVII, p. 132.

<sup>21</sup> Halban (Monatsschr. f. Geb. u. Gynäk., 1900, XI, p. 102) states that he has found lactose once in the amniotic fluid of a normal puerpera. Further studies of this subject are needed.

which *Bacillus aërogenes capsulatus* was demonstrated. Although as some of our cases show, this condition may be associated with invasion of the bacilli into the wall of the uterus and by acute gas-sepsis, these occurrences are exceptional and the prognosis is in general a favorable one. Most of the cases furnish a good illustration of the resistance of living human tissues to the action of the gas-bacillus. Doubtless in these cases the bacilli grow simply in the amniotic fluid after rupture of the membranes, and in the dead fetus, these offering no vital resistance, whereas we must suppose that the intact uterine wall offers ordinarily an effective resistance to the invasion and multiplication of the gas-bacillus. That occasionally the bacilli may find other dead material in the uterus, as in sloughing myomata and cancers, is evident from the histories of some cases of physometra.

*Emphysema of the Uterine Wall*.—Far graver in significance is septic emphysema of the uterine wall, of which Halban<sup>22</sup> has recently reported an interesting case due to *Bacillus aërogenes capsulatus*. Graham, Steward and Baldwin and P. Ernst were the first to demonstrate this bacillus in this condition, their papers, to which reference has already been made, appearing simultaneously in August, 1893. Eleven instances of emphysema of the wall of the uterus, all puerperal, have been reported, of which 5 were recognized during life. In all but Halban's case there was also physometra, and this would seem to be a necessary accompaniment unless the cervical canal is open so as to permit the escape of the gas from the uterine cavity. All of the cases were fatal, and in most gas was found at autopsy in the blood and internal organs.

Subperitoneal emphysema is a condition which has been observed after rupture of the uterus, Dischler<sup>23</sup> having collected reports of 14 cases. In most instances this has been attributed to entrance of air, but I think that it is safe to predict that the gas-bacillus will be found in similar cases in the future, if proper methods for its detection are employed. I know, however, of no instance of this condition in which it has been looked for.

*Puerperal Gas-Sepsis*.—I have adopted from Halban the term "gas-sepsis" as a convenient one—although, perhaps, open to criticism—to designate the important group of fatal puerperal cases in which gas-bubbles are found at early autopsies in the heart and vessels and often also in the organs and tissues under conditions where we must suppose that gas-bacilli and possibly gas have passed from the uterus into the circulation during life.<sup>24</sup> Here in my opinion belong most of the cases which have been reported as deaths due to the entrance of air into the uterine veins. This opinion which I expressed in my first communications on the gas-bacillus in 1891 and 1892, received prompt confirmation in the papers

<sup>22</sup> Monatsschr. f. Geb. u. Gynäk., 1900, XI, p. 88.

<sup>23</sup> Arch. f. Gynäk., 1898, LVI, p. 199.

<sup>24</sup> Gas-sepsis in this sense occurs also in other than uterine infections with the gas-bacillus.



of Graham, Steward and Baldwin and of P. Ernst in August, 1893, and has since been strengthened by other similar observations. Cases described by Wendeler<sup>29</sup> as sepsis acutissima belong also in the same category.

My list includes 13 puerperal cases in which gas-bubbles and the gas-bacillus were found at autopsy in the blood or organs; but in only 7 of these does it seem to me conclusive or extremely probable that the infection occurred during life.<sup>30</sup>

The most remarkable of these cases is that reported by Graham, Steward and Baldwin of a woman, upon whom abortion had been recently produced, who during the four hours immediately preceding death became emphysematous over nearly the whole body. At the autopsy gas and gas-bacilli were found everywhere throughout the body. In Dalton and Bremer's<sup>31</sup> case, also one of criminal abortion, an emphysematous swelling of the arm and pectoral region was likewise recognized during life. These cases are of importance as demonstrating the invasion of the body by the gas-bacillus from the uterus while the blood is still circulating. In Halban's and Dobbin's cases gas was also recognized during life within the wall or cavity of the uterus.

In the majority of cases of puerperal gas-sepsis there has been some operative interference preceding infection, such as criminal abortion, forced delivery for placenta prævia or other causes, or the manipulations of an unskilled midwife. The fulminating character of the infection, death being sometimes very sudden, is a notable feature of many of the cases.

In a case of attempted criminal abortion reported by Perkins<sup>32</sup> the patient, according to the statement of the practitioner in whose office death occurred, died suddenly, and at the autopsy twelve hours later in cold weather, gas was found in the vena cava, heart, and other vessels, with evidences of injury to the pregnant uterus. The case was reported by Perkins as one of death from air-embolism, and certainly with as much and even more plausibility than most cases thus reported. After the publication, Dr. Perkins, upon the request of Dr. Dobbin, was so good as to send the uterus, well preserved in alcohol, to my laboratory where Dr. Dobbin demonstrated in the uterine vessels and tissue bacilli morphologically and in staining reaction identical with *Bacillus aërogenes capsulatus*.<sup>33</sup>

I would not be understood to deny the possibility of the occurrence of fatal air-embolism from the uterus. A very few of the reported cases are difficult to interpret upon any

other supposition, but I do claim that the foundations of this doctrine have been seriously shaken by our discovery and investigations of the gas-bacillus, and that no case, however plausible, can be considered as positively proven without a satisfactory bacteriological examination. The limitation of gas to the right heart and adjacent vessels may occur from invasion by the gas-bacillus, and is not, as often represented, peculiar to air-embolism. Did we not know how long it takes new knowledge, especially that originating in this country, to penetrate throughout the medical world, it would be amazing that cases should still continue to be reported, as they are,<sup>34</sup> of deaths ascribed to air-embolism without any bacteriological examination or even any reference to the possibility of any other explanation. I am not aware that in any instance of alleged air-embolism, a bacteriological examination has been made, which would exclude the presence of gas-forming bacteria.

Whether, as suggested by Staude, in any of the cases with gas within the uterine cavity, death is attributable to gaseous embolism, is, I think, an open question. It is possible, although I know of no proof of it, that in some of the cases of sudden death during or immediately after some manipulation or operation on the pregnant uterus and attributed to air-embolism, gas, generated by bacteria, may have existed under pressure within the uterine cavity and have entered wounded veins in sufficient amount and so suddenly as to have caused death.

To what extent the free gas found in the blood-vessels, heart and internal organs, even very soon after death from what has been described as puerperal gas-sepsis, is there during life, is a question difficult to answer. I have already considered this subject, and in this connection shall again emphasize the importance of caution in interpreting the presence of gas in these situations as a vital phenomenon, although there is evidence that it may be such.

#### INFECTIONS OF THE URINARY TRACT.

There is evidence that the urinary tract may not only be a portal of entrance for the gas-bacillus into the circulation or adjacent tissues but also be itself the seat of infection by this organism. Unfortunately for the decisive interpretation of many of these cases, *Bacillus aërogenes capsulatus* has, so far as I am aware, hitherto been found in the urinary tract only after death, although in some instances so soon thereafter and under such conditions that its presence during life cannot be doubted.

I have already called attention to instances of emphysematous gangrene following external urethrotomy and other operations on the urinary passages.

<sup>29</sup> Zorn (Münch. med. Woch., 1898, p. 567) may be cited as an example. Hübl (Wiener klin. Woch., 1900, XII, p. 111) has also recently reported two instances of alleged air-embolism—placenta prævia—without any bacteriological examination. He assumes incorrectly that the distribution of the gas at autopsy is a decisive point as between air-embolism and gas-sepsis.

<sup>29</sup> Monatsschr. f. Geb. u. Gynäk., 1896, IV, p. 581.

<sup>30</sup> These are the cases reported by Graham, Steward and Baldwin, P. Ernst, Menge and Krönig, Dobbin, F. C. Wood (Med. Record, Apr. 15, 1899), Cesaris-Demel, and Halban, to whose papers references have already been given.

<sup>31</sup> Am. Journ. Med. Sc., 1888, XCV, p. 594. This infection, although attributed to the bacillus of malignant œdema, was probably due to the gas-bacillus.

<sup>32</sup> Boston Med. and Surg. Journ., 1897, CXXXVI, p. 154.

<sup>33</sup> Dobbin has reported the results of his examination with further notes of this case in the Monatsschr. f. Geb. u. Gynäk. 1897, VI, p. 375.

Among the cases of general invasion of the blood and organs (foamy organs) by the gas-bacillus observed by myself and others are several in which the portal of entry was the urethra, bladder or other part of the urinary tract.<sup>85</sup> In a case of urethral stricture with cystitis, for which perineal section had been done, reported by Welch and Flexner, gas-bacilli were found *three-quarters of an hour after death* in large numbers in the bladder, ureters and renal pelvis, and a few gas-bubbles and gas-bacilli were already present in the blood of the right ventricle. In Howard's case of meningitis caused by the gas-bacillus, to be cited subsequently, he considers that the portal of entry was the urinary tract.

Gas, generated by *Bacillus aerogenes capsulatus*, has been found in the urinary passages in 6 cases which have come to my notice.<sup>86</sup> The gas may be either free in the cavity of the bladder, ureters or renal pelvis, or contained within submucous blebs, or in both situations.

Welch and Flexner<sup>87</sup> have reported an instance of pneumaturia in a diabetic man in whom, six hours after death, without trace of cadaveric decomposition, the urinary bladder was found filled with frothy urine containing *Bacillus aerogenes capsulatus* in pure culture. This case indicates that the colon bacillus and *Bacillus lactis aerogenes* are not the sole causes of pneumaturia in diabetics. Dr. Flexner has given me the notes of a second case of pneumaturia upon which he made the autopsy at the University Hospital, Philadelphia. This was of a patient with chronic cardiac disease who had been catheterized twenty-eight hours before admission and who died thirty hours after admission. At the autopsy, made one hour and a half after death, about 60 cc. of frothy urine were found in the bladder from which *Bacillus aerogenes capsulatus*, together with *Staphylococcus aureus* and *Streptococcus pyogenes* (no colon bacilli), was cultivated. Neither gas nor gas-bacilli were found elsewhere in the body. The mucous membrane of the bladder was oedematous. There can be little doubt that in this case the gas-bacillus was introduced by the catheter into the bladder.

In one of Welch and Flexner's cases (Case XVIII) of hypertrophied prostate with pyoureter and pyonephrosis, the renal pelvis and ureters were found at autopsy distended with gas and containing pus mixed with bubbles of gas. Small gas-cysts were present in the mucous membrane of the renal pelvis. Neither gas nor gas-bacilli were present outside of the urinary organs. In this case cocci and colon bacilli were associated with the gas-bacillus.

In a case of Dr. Kelly's, of which the full records have been given me by Dr. Miller,<sup>88</sup> there was pneumaturia demon-

strated by cystoscopic examination and ureteral catheterization to come exclusively from the inflamed left renal pelvis and ureter. Among cocci and other bacteria were found on coverslips bacilli morphologically resembling *Bacillus aerogenes capsulatus*, but unfortunately no anaërobic cultures were made. None of the bacteria which grew aerobically produced gas in lactose-agar. This case is interesting as demonstrating that the gas may come exclusively from one renal pelvis and ureter, but the microorganism producing the gas was not satisfactorily demonstrated. It seems certain that it was an anaërobic organism, and from the microscopical appearances may have been the gas-bacillus.

The subject of submucous gas-cysts will be considered subsequently; but here it may be mentioned that besides the gas-cysts in the renal pelvis noted by Welch and Flexner in the case already cited, Goebel found gas-blebs, containing in pure culture *Bacillus aerogenes capsulatus*, beneath the mucous membrane of the urinary bladder, without gas elsewhere in the body, and Dunham has reported a like condition of the bladder in a case of emphysematous gangrene with general invasion of the blood and organs by the gas-bacillus.

Bacteria have been found in emphysema of the bladder (cystitis emphysematosa) also by Eisenlohr,<sup>89</sup> Camargo,<sup>90</sup> and Kedrowsky,<sup>91</sup> but it is impossible from the authors' descriptions to identify their bacteria. Kedrowsky considers that the bacillus isolated by him is allied to *Bacillus aerogenes capsulatus*, but less sensitive to oxygen. Perhaps it was Sanfelice's *Bacillus pseudo-oedematis maligni*, to which I have already referred, but Kedrowsky's description of his cultures hardly inspires confidence in their purity.

Welch and Flexner and Howard have reported finding the gas-bacillus, in association with other bacteria, in inflammatory lesions of the bladder, renal pelvis and kidneys, without the detection of gas. Howard considers that in one of his cases the bacillus was concerned in the etiology of suppurative lesions of the kidneys but in this case the colon bacillus and *Streptococcus pyogenes* were also present.

#### INFECTIONS DERIVED FROM THE GASTRO-INTESTINAL CANAL.

Mention has already been made of the frequent, if not constant, presence of *Bacillus aerogenes capsulatus* in the intestinal canal, of gaseous phlegmons originating from this source, and of the readiness with which intestinal bacteria may gain access to the genito-urinary tract.

The intestine is by far the commonest source of the gas-bacilli found together with gas-bubbles in the blood and organs at autopsies. This invasion may occur either with or without definite intestinal lesions, and is probably in the majority of cases an agonal or post-mortem event. The mode of distribution and spread of the bacilli in these cases has

<sup>85</sup> Such cases are reported by Welch and Flexner, Goebel, Dunham and Howard in papers already cited.

<sup>86</sup> These do not include some instances of very extensive post-mortem emphysema of the organs with gas everywhere throughout the body.

<sup>87</sup> Case XIII of our list in *Journal of Experimental Medicine*, 1896.

<sup>88</sup> This case is briefly reported by Kelly and MacCallum, *Journ.*

*Amer. Med. Assoc.*, 1898, XXXI, p. 376, whose paper may be consulted for the full literature of pneumaturia.

<sup>89</sup> *Ziegler's Beitr.*, 1888, III, p. 101.

<sup>90</sup> *Thèse de Genève*, 1891.

<sup>91</sup> *Centrbl. f. allg. Path. u. path. Anat.*, 1898, IX, p. 817.

been well described by Howard,<sup>77</sup> whose experience has been exceptionally large with this class of affections. Especially demonstrative of invasion of gas-bacilli from the intestine, usually post mortem, is the occurrence of gas-bubbles limited to the neighborhood of the intestine, as in the intestinal wall, within the portal or mesenteric veins, or lymphatics, in the subperitoneal tissues, mesentery and omentum, around the pancreas, in the mesenteric gland, and especially in the loose tissue near the gall-bladder and in the porta of the liver, without gas in more remote situations. I have seen examples of each of these occurrences in very early autopsies without ordinary cadaveric decomposition.

*Local Gastro-intestinal Lesions.*—Interstitial emphysema of the gastro-intestinal wall will be considered subsequently.

Howard has described several cases with larger or smaller areas of superficial necrosis of the mucous membrane of the stomach and intestine, in which gas-bacilli were present in large numbers. These areas, which may occur either with or without gas-cysts, are found most frequently beneath the folds of the valvulae conniventes and are characterized by absence of nuclear staining and disintegration of the cells and tissue, usually without marked inflammatory reaction.

*Bacillus aerogenes capsulatus* may undoubtedly be a cause of meteorism. Instances of this are reported by Welch and Flexner and by Howard.

*Pneumo-peritonitis with and without Perforation.*—My records include 13 cases of diffuse peritonitis in the exudate of which *Bacillus aerogenes capsulatus* was found. Eleven of these were in autopsies made either by Dr. Flexner or myself, 7 having already been published by us in 1896. The remaining 2 cases (both being perforations of gastric ulcers) have been reported by Page<sup>78</sup> and by Pratt and Fulton.<sup>79</sup> It was the observation of these cases which first called my attention to the frequent presence of the gas-bacillus in the intestine.

Ten of the cases were perforative and 3 were non-perforative. Of the former 4 were the result of perforation of typhoid ulcers, 4 of gastric ulcers,<sup>80</sup> one of strangulated, gangrenous intestine and one of a cancerous ulcer of the duodenum. In the last case (autopsy fourteen hours after death) the exudate was sero-fibrinous and the gas-bacillus was found in pure culture<sup>81</sup> and abundantly in the peritoneal cavity and

was absent from other organs and the blood. In the other perforative cases the gas-bacillus was mixed with other bacteria, although in some instances it predominated. In all of the cases the abdomen was greatly distended with gas and usually there was great tympanites.

I attach especial importance to the case fully reported by Welch and Flexner,<sup>82</sup> in which we brought conclusive evidence of the occurrence of pneumoperitonitis without perforation, the first of the kind on record in which similar proof was obtained. The presence of gas in the peritoneal cavity was recognized during life. Since our publication a similar case has been observed by Dr. Flexner in Manila, who has kindly furnished me the notes. At the autopsy, twelve hours after death, there was found hæmorrhagic infarction of the lower part of the ileum and adjacent part of the large intestine, caused by the passage of this part of the intestine through a hole in the mesentery. The peritoneal cavity was greatly distended with gas which burnt with a pale, blue flame. There was a large amount of frothy, bloody serum in the peritoneal cavity together with a fibrinous exudate. The most careful examination showed no perforation. *Bacillus aerogenes capsulatus* was obtained in pure culture and abundantly from the peritoneal fluid. Gas was absent from the blood and other organs.

We have found the gas-bacillus, mixed with other bacteria, twice in circumscribed, gas-containing, intraperitoneal abscesses resulting from perforation of the appendix vermiformis.

*Hepatic and Biliary Infections.*—The development of gas in the liver is so striking a phenomenon in most autopsies where the gas-bacillus and free gas are found in the blood and organs that P. Ernst used the term "Schaumleber" for the title of his article on the gas-bacillus, published a year after the paper by Welch and Nuttall, in which we first directed attention to the subject of foamy organs and the gas-bacillus.<sup>83</sup> I have already considered the general subject of gas-bubbles in the blood and organs, and wish here to call attention especially to infections of the gall-bladder and biliary passages by *Bacillus aerogenes capsulatus*.

In cases of foamy liver gas may be found in the bile-ducts and gall-bladder, but my experience is that, when the gas-bacilli reach the liver through the blood-vessels, the appearance of gas in these situations is a rather late occurrence and met chiefly in advanced cases. In contrast to these cases are the observations of gas in the biliary passages, associated sometimes with definite lesions of the bile-ducts and liver, where the evidence is that the gas-bacilli entered from the

<sup>77</sup> Op. cit., p. 491.

<sup>78</sup> Canada Lancet, May, 1900.

<sup>79</sup> Boston Med. and Surg. Journ., June 7, 1900, p. 599.

<sup>80</sup> Welch and Flexner have reported an instance of peritonitis from perforated gastric ulcer in a rabbit, in which the gas bacillus was found.

<sup>81</sup> The purity of the culture in this case is explicable by the results of Cushing and Livingood's interesting bacteriological and experimental studies of the duodenal flora published in Contributions to the Science of Medicine, Dedicated by his pupils to William Henry Welch on the 25th Anniversary of his Doctorate, p. 543, Baltimore, 1900.

<sup>82</sup> Op. cit., p. 35.

<sup>83</sup> Heydenreich's paper on "Emphysem der Leber" (Centralbl. f. Bakter., 1897, XXI, p. 305) may be mentioned as a curiosity. He had never heard of the gas-bacillus or of any other investigation of the subject later than 1872. In contrast to this is the interesting article of P. Bernhardt on pneumæthemia and foamy organs with full consideration of the recent literature. Deutsche med. Woch., 1900, p. 83.



intestine directly into these passages. Two such cases have been reported by Howard,<sup>100</sup> and I have observed two cases.

Pratt and Fulton<sup>101</sup> report a remarkable case of cancer of the common bile-duct and pancreas in which cholecystotomy was performed, the edges of opening in the gall-bladder being stitched to the abdominal walls. At the autopsy the liver was found studded with minute abscesses with greenish translucent walls. In coverslips, sections and cultures *Bacillus aerogenes capsulatus* was found in pure culture in these small biliary abscesses, but there was no gas in the abscesses, the liver, blood, or other organs. A somewhat similar case, in which cholecystenterostomy for gall-stones had been performed, was previously reported by Nicholls<sup>102</sup> from Adami's laboratory. Here also multipleiliary abscesses containing the gas-bacillus were found in the liver, but in this case gas was present in the liver, as well as in the blood and other organs, the autopsy being six hours after death. Larkin<sup>103</sup> has likewise reported a case of hæmorrhagic pancreatitis with fat necroses and small, multiple hepatic abscesses with gas-holes in the liver, from which *Bacillus aerogenes capsulatus* was isolated. The autopsy was eight hours after death.

Hintze<sup>104</sup> has recorded a post-mortem observation of gas in the inflamed bile-ducts with cholelithiasis. He cultivated only the colon bacillus, but it does not appear that he made anaërobic cultures.

From the foregoing cases it is to be inferred that the gas-bacillus may invade the bile-ducts and gall-bladder from the intestine, and sometimes during life, and that it may not only produce gas but also necroses and purulent inflammation. The presence of gall-stones, cancer of the bile-ducts and operations on the gall-bladder favor this mode of infection.

Rist<sup>105</sup> found the gas-bacillus (*Bacillus perfringens*), without gas or other lesion attributed to it, in an extirpated gall-bladder containing a calculus and clear viscid fluid.

#### INTERSTITIAL EMPHYSEMA OF THE GASTRO-INTESTINAL, GENITO-URINARY AND BILIARY TRACTS.

One of the most interesting lesions produced by *Bacillus aerogenes capsulatus* is the formation of submucous or subserous gas-cysts or blebs, of which the earliest examples attributed to this organism were reported by P. Ernst, Goebel, and Welch and Flexner. They are sufficiently common to have been observed by nearly all investigators who have had much experience with the gas-bacillus in human beings. My list of cases includes 25 instances of this condition, of which 5 were of the stomach, 11 of the intestine (far oftener of the small than the large intestine), 5 of the gall-bladder and bile-

ducts, 3 of the urinary bladder, 1 of the renal pelvis, and 1 of the vagina. The majority of the cases were observed by Flexner, Howard, and myself, and in all the gas-bacillus was demonstrated. The case of emphysema of the vagina was reported by Lindenthal.<sup>106</sup>

These gas-cysts vary in size from microscopic dimensions to large blebs. They are most common in the submucous coat, but may be present in the mucous membrane, the muscular coat or beneath the serous covering, in fact, in any part of the membranous wall. They may be few or in enormous numbers, in groups or scattered. In one of our cases the whole small intestine from the duodenum to the ileocecal valve was studded with small gas-cysts. Gas-cysts of the same general character may be found in the mesentery and omenta.

These gas-cysts are in their inception simply such gas-holes as we are already familiar with in the liver and other organs in cases of local or general invasion with the gas-bacillus. They indicate a foamy or emphysematous condition of the walls of the stomach, intestine, gall-bladder, bile-ducts, urinary bladder and vagina, due to the invasion into these parts of the gas-bacillus.

The condition of the walls of the blebs and of the surrounding tissues varies. Some of the cavities are round and their walls smooth, others are irregular in shape and have ragged walls. They may correspond to dilated lymphatics, but more frequently they do not represent dilatation of any performed channels. There may be communication between adjacent cavities, but oftener the cysts are distinct from each other. The tissue in the immediate neighborhood of the cavities may present no alteration not explicable by the mechanical pressure of the gas, or it may show necrosis in varying degree and extent. Inflammatory changes or cellular reaction which could be reasonably referred to the presence of the cysts or of the gas-bacilli causing them were not noted. Sometimes a little coagulated, homogeneous or granular material is present in sections of the cysts in hardened tissues, as indeed may often be found in gas-holes in the organs.

In sections stained by Gram there is usually no difficulty in demonstrating the relation of the gas-bacilli to the cysts. The bacilli may be in masses in the walls of the cysts, but sometimes they are not more numerous there than in the tissue at a distance from the gas-blebs, and occasionally it requires some searching to find them. By anaërobic methods the gas-bacillus can be cultivated from the cysts or the adjacent tissue.

All of the instances of submucous and subserous gas-cysts in my list were observed post mortem. In the larger number of cases gas-bacilli and gas-bubbles were more or less widely distributed in the blood and organs, but without evidences of ordinary post-mortem decomposition. There are, however, several cases in which these gas-cysts in various situations were the sole manifestation of the presence of the gas-bacillus in the body. Howard has shown that if careful, systematic

<sup>100</sup> Contributions to the Science of Medicine, Dedicated by his pupils to William Henry Welch on the 25th Anniversary of his Doctorate, pp. 475 and 476, Baltimore, 1900.

<sup>101</sup> Boston Med. and Surg. Journ., June 7, 1900, p. 599.

<sup>102</sup> Brit. Med. Journ., 1897, II, p. 1844.

<sup>103</sup> Med. Record, 1898, LIII, p. 354.

<sup>104</sup> Münch. med. Woch., 1895, XLIII, p. 209.

<sup>105</sup> Thèse, Paris, 1898.

<sup>106</sup> Wiener klin. Woch., 1897, pp. 3 and 35.

search is made for areas of necrosis and minute gas-cysts due to *Bacillus aërogenes capsulatus* in the stomach and intestine, these lesions can be found much more frequently than has been supposed.

It is, with our present information, a difficult matter to say in how many of these cases the emphysematous state existed before death. It is certain that, at least in the great majority of cases in my list, the emphysema was not the result of ordinary post-mortem decomposition. In a large number of the cases the autopsy was made within a few hours after death. Howard, in one of his cases of gas-cysts, limited to the intestine, made the autopsy one hour after death. I have already emphasized the importance of great caution in interpreting as vital processes the various gaseous conditions of parts and organs not open to inspection during life, even when autopsies are made soon after death and there is entire absence of putrefaction, and I can only repeat this caution here. Mere absence of nuclear staining around gas-holes I do not regard as proof of their origin during life.

It would lead altogether too far to enter here into a discussion of the general subject of submucous gas-cysts concerning which there is a large literature, the principal references to which will be found in the articles of Eisenlohr,<sup>106</sup> Camargo,<sup>107</sup> Winands,<sup>108</sup> Orlandi,<sup>109a</sup> Dupraz<sup>109</sup> and Lindenthal.<sup>110</sup> It would appear from a study of the records of the subject that anatomically different conditions have been described under the designation "gas-cysts" (cystides aërifères). Some have been apparently of long standing and show chronic inflammatory changes in the walls of the cysts and the surrounding tissues. The most voluminous records relate to the gas-cysts of the vagina (kolpolyperplasia cystica of Winckel, emphysema vaginæ of Eppinger).

At present we have no warrant to identify the more chronic gas-cysts with thickened walls with the more acute emphysematous condition which I have described as referable to *Bacillus aërogenes capsulatus*. Nevertheless the former are probably of bacterial origin also, although I am unable to accept the bacteriological findings of Eisenlohr, Camargo, Orlandi and Dupraz as at all convincing, for they made no use of anaërobic methods of cultivation. It is quite possible that *Bacillus aërogenes capsulatus* is concerned also in the etiology of the gas-cysts of long standing; certainly it is important to apply hereafter anaërobic cultural methods to their study. Lindenthal has no hesitation in identifying the emphysema of the vagina observed by him post mortem and from which in a single case he cultivated what he chooses to call *Bacillus emphysematis vaginæ* (in reality our *Bacillus aërogenes capsulatus*) with Winckel's kolpolyperplasia cystica, but, while

he may be correct, further observations are needed before their anatomical and etiological identification can be accepted.

The only instance in which gas-cysts of the human intestine have been recognized during the life of the patient is reported by Hahn,<sup>111</sup> who found them in large number upon opening the abdomen. It is to be regretted that no thorough bacteriological examination of this case was made.

In my original communication on the gas-bacillus I ventured the surmise that the bacillus found by E. Fraenkel<sup>112</sup> in hardened sections from a case of gastritis emphysematosa might be identical with *Bacillus aërogenes capsulatus*, and this suspicion has gained in probability by Goebel's statements based upon a re-examination of the sections, his work having been done under Fraenkel's supervision.

Notwithstanding an effort at compression, so much space has been occupied in the presentation of the foregoing subdivisions of our subject, which in less than a decade has grown to considerable magnitude, that I shall only summarize very briefly a few remaining topics, although all deserve fuller treatment.

*Pulmonary and Pleural Infections.*—To the two instances of invasion of the lungs by the gas-bacillus reported by Welch and Flexner, I can add the cultivation of this organism from a gangrenous lung by Dr. Flexner in my laboratory. It has been found also by Guillemot<sup>113</sup> and Rist<sup>114</sup> in pulmonary gangrene.

Of much importance is Levy's<sup>115</sup> demonstration of *Bacillus aërogenes capsulatus* as a cause of pneumothorax without perforation. This case and those of pneumoperitonitis without perforation to which I have already referred have settled affirmatively the long standing controversy concerning the possibility of the generation of gas within closed serous sacs during life. Nicholls<sup>116</sup> has reported an instance of pneumothorax and pneumopericardium without perforation in which the gas-bacillus was probably present. Rendu and Rist<sup>117</sup> also isolated the gas-bacillus (*Bacillus perfringens*) in a case of putrid pleurisy with gas. May and Gebhart<sup>118</sup> and Finley<sup>119</sup> attribute their two cases of pneumothorax without perforation to the colon bacillus, but in neither were anaërobic cultures made. It is important that in all gaseous affections anaërobics should be searched for.

#### *Bacillus Aërogenes Capsulatus in the Blood during Life.*—

<sup>111</sup> Deutsche med. Woch., 1899, p. 657.

<sup>112</sup> Virchow's Archiv, 1889, CXVIII, p. 526.

<sup>113</sup> Thèse, Paris, 1899.

<sup>114</sup> Thèse, Paris, 1898.

<sup>115</sup> Arch. f. exp. Path. u. Pharm., 1895, XXXV, p. 335.

<sup>116</sup> Loc. cit.

<sup>117</sup> Bull. et mém. Soc. méd. d. hôp. de Paris, 1899, 3. S., XVI, p. 133.

<sup>118</sup> Deutsches Arch. f. klin. Med., 1898, LXI, p. 323.

<sup>119</sup> Philadelphia Monthly Med. Journ., 1899, I, p. 569.

<sup>106</sup> Ziegler's Beiträge, 1888, III, p. 101.

<sup>107</sup> Thèse de Genève, 1891.

<sup>108</sup> Ziegler's Beiträge, 1895, XVII, p. 38.

<sup>109a</sup> Gazz. med. di Torino, 1896, XLVII, p. 781.

<sup>109</sup> Arch. de méd. expér., 1897, IX, p. 282.

<sup>110</sup> Wiener klin. Wochenschr., 1897, pp. 3 and 35.

Extremely interesting is the demonstration by Gwyn,<sup>129</sup> both by coverslip specimens and by cultures, on repeated examinations, of *Bacillus aërogenes capsulatus* during life in the blood of a patient, in the Johns Hopkins Hospital, with chorea insanienis and acute endocarditis. I had the opportunity of examining his cultures, which were entirely typical. The patient died but unfortunately no autopsy could be obtained. There was no evidence during life of free gas in the blood or tissues. The case is of importance as demonstrating that gas-bacilli may be in the circulating blood for days in sufficient number to be demonstrable both microscopically and culturally without evidence of free gas. I have already expressed my suspicion that Achalmé's anaërobic bacillus, which has likewise been cultivated from the blood, as well as from the tissues, of several cases of acute articular rheumatism, is identical with *Bacillus aërogenes capsulatus*.

*Presence of Bacillus Aërogenes Capsulatus without Gas.*—In this connection I may say that the gas-bacillus may be present and even multiplying within the human body without the production of gas. Certain organs, above all the liver, offer much more favorable pabulum for the generation of gas than do others, but even in the liver the bacilli may be present without gas. I have found gas-bacilli in clumps within the spleen and kidney, surrounded by areas of necrosis, without recognizable gas.<sup>129a</sup> I have already cited the demonstrations by Cushing and by Pratt and Fulton of the gas-bacillus in small abscesses without gas, the observation of the latter being particularly complete and satisfactory. Rist<sup>130</sup> has cultivated the gas-bacillus (*Bacillus perfringens*) from cases of fetid otorrhea and of mastoid abscess. He does not mention the presence of gas in these cases. I have already cited his isolation of this bacillus from the gall-bladder which contained no gas.

Dr. Harris in my laboratory isolated the gas-bacillus in pure culture from an abscess containing blood and pus in the neck of a dog, following an operation on the jugular vein. There was no gas in the abscess. Aërobic cultures were entirely negative. These observations, however, are not the only ones demonstrating that the gas-bacillus may under certain circumstances and in certain situations manifest pyogenic capacity.

*Meningitis. Pyogenic Capacity of Bacillus Aërogenes Capsulatus.*—Howard,<sup>131</sup> in April, 1899, reported a case of acute fibrino-purulent meningitis, following operation for urethro-perineal fistula. *Bacillus aërogenes capsulatus* was found in pure culture in the meningeal exudate. Likewise Hitschmann and Lindenthal<sup>132</sup> have recorded another convincing example of acute cerebral meningitis, following fracture of the occipital bone, in which the gas-bacillus was found unmixed with other bacteria. These authors call attention to the pyogenic power of the gas-bacillus when it attacks the meninges, but, as already shown, the same power may be manifested elsewhere.

*Cavities in the Brain.*—Finally I would call attention to Reuling and Herring's<sup>133</sup> and Howard's studies of cavities in the brain produced by *Bacillus aërogenes capsulatus* and to the light which their observations shed upon certain obscure examples of cerebral cavities previously reported.

In this excursion into pneumato-pathology I have invited you to the survey of fields comparatively new and little trodden. I can only hope that our journey has been not without some interest and some profit to you. To me the opportunity to present before such a body as the Massachusetts Medical Society the results of these investigations is one which I highly appreciate.

I desire in closing to pay my tribute of respect and to call to your grateful remembrance the founder of this lectureship, Dr. George Cheyne Shattuck. That the subject of this address would not have been without interest to him may be inferred from the title of his first Boylston Prize dissertation on the theme propounded in 1806 and entitled: "The difference between mortification produced by an external cause and that which is produced by a constitutional defect, the diagnostics and proper mode of treatment of each."<sup>134</sup> By his noble character, professional services and liberality Dr. Shattuck deserved well of the medical profession of his city and state, and, indeed, of the whole country, and his memory is worthily perpetuated not only by the foundation of this lectureship but also by the endowment of the chair of morbid anatomy in the Harvard Medical School.

<sup>129</sup> Bulletin of the Johns Hopkins Hospital, 1899, X, p. 134.

<sup>129a</sup> Cesaris-Demel's (loc. cit.) opinion that generation of gas in the tissues is merely a putrefactive process pertaining not to any particular kind of microorganism but to irreparable necrosis or damage of the tissues, whereby they become the prey of indifferent gas-producing bacteria, is not proven by his own observations and is opposed by many facts described in this paper.

<sup>131</sup> Thèse, Paris, 1898.

<sup>132</sup> Bulletin of the Johns Hopkins Hospital, 1899, X, p. 66.

<sup>133</sup> Op. cit.

<sup>134</sup> Bulletin of the Johns Hopkins Hospital, 1899, X, p. 62.

<sup>135</sup> Published in Boston in 1808.

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## ON THE HISTOLOGY OF THE ISLANDS OF LANGERHANS OF THE PANCREAS.

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The pancreas is much more complex in structure than the other glandular organs which it closely resembles. Langerhans,<sup>1</sup> in an inaugural dissertation published in 1869, gave the first careful description of its histology and showed that the organ has not the relatively simple structure of the salivary glands.

Langerhans studied the pancreas of rabbits which in its essential features does not differ from that of other mammals. The larger ducts are lined by epithelium composed of a single layer of high columnar cells. As the branches of the duct become smaller, the epithelial cells become lower, cubical, and finally flat or, as seen in section, spindle shaped, the nucleus occupying the thicker central portion. The smallest ducts end in the acini composed of high columnar characteristically glandular cells containing next the lumen numerous zymogen granules. Within almost every acinus in contact with the secreting cells Langerhans found one, two, or more cells of a different nature, and to these he gave the name *centro acinar cells*. They closely resemble the flat spindle-shaped cells lining the very small ducts and he thinks that the epithelium of the duct is continued over the secreting cells into the lumen of the acinus, but he admits that he is unable to determine with exactness the method by which the duct ends.

Distributed at intervals in the parenchyma are groups of cells differing markedly from those of the ordinary glandular type. Such groups are usually round and in tissue, treated two or three days with Müller's fluid, appear with low magnification, as intensely yellow specks. With high magnification they are found to be composed of small, irregularly polygonal cells with a round nucleus and a refractive homogeneous cell body. Of the nature of these cell groups Langerhans declares himself entirely ignorant.

Numerous observers have described these structures which are usually designated islands of Langerhans. Renault,<sup>2</sup> regarding them as analogous to lymph follicles, speaks of them as "*points folliculaires*." Podwysotski<sup>3</sup> calls them pseudo-follicles. They have been designated secondary cell groups, inter-alveolar cell islets, etc.

In injected specimens Kühne and Lea<sup>4</sup> found scattered through the organ glomerular structures composed of dilated

and tortuous capillaries and showed that these glomeruli correspond to the cell groups which Langerhans described. The islands are penetrated by numerous wide tortuous capillaries which lie between cells forming irregular anastomosing columns. Material injected into the duct of the gland does not penetrate the islands.

Interacinar cell islets have been studied by Harris and Gow,<sup>5</sup> and recently by Diamare,<sup>6</sup> in a great variety of animal species, including mammals, birds, amphibia and reptiles.

Laguesse<sup>7</sup> has studied the development of these bodies in sheep embryos and has reached conclusions which have not, I believe, been confirmed. He finds that at an early period of growth the pancreas is composed of tortuous tubules formed by a single layer of epithelial cells. Here and there occur cells which stain more deeply than those about them and, like the border cells of the stomach, are situated near the outer surface of the tubule. These cells proliferate and form what he calls primary islands of Langerhans. Accepting the observations of Lewaschew, to be mentioned later, he thinks that after development of the organ is completed similar structures, secondary islands of Langerhans, are formed from groups of secreting acini.

Various opinions are held concerning the nature of the interacinar cell groups. The suggestions which have been advanced may be classified as follows: (1) The islands of Langerhans, having the same origin as the secreting elements of the gland, are formed during embryological life and persisting thereafter probably subserve some special function. (2) They represent a stage in the embryological development of the gland acini and those found in the adult organ are persistent rudimentary structures. (3) They are follicles of lymphatic tissue scattered through the organ. (4) They are modified acini, transformed as the result of functional activity of a peculiar nature.

When throughout the gland structures are found composed of cells differing from those of the acini, having a different arrangement and bearing a peculiar relation to the blood-vessels, it seems probable that, formed in embryological life, they possess an anatomical identity as definite as that of the glomeruli of the kidneys or the Malpighian bodies of the

<sup>1</sup>Langerhans. *Beiträge zur mikroskopischen Anatomie der Bauchspeicheldrüse*. Inaug.-Diss., Berlin, 1869.

<sup>2</sup>Renaut. *Sur les organes lymphoglandulaires et la pancreas des vertebres*. *Compt. rend. d. l'Acad. d. Sciences*, LXXXIX, 247, 1879.

<sup>3</sup>Podwysotski. *Beiträge zur Kenntniss des feineren Baues der Bauchspeicheldrüse*. *Arch. f. mikrosk. Anat.*, XXI, 765, 1882.

<sup>4</sup>Kühne and Lea. *Beobachtungen über die Absonderung des Pancreas*. *Untersuch. a. d. Physiolog. Instit d. Univ. Heidelberg* II, 488, 1882.

<sup>5</sup>Harris and Gow. *Note upon One or Two Points in the Comparative Histology of the Pancreas*. *Jour. of Phys.*, XV, 349, 1894.

<sup>6</sup>Diamare. *Studi comparativi sulle isole di Langerhans del pancreas*. *Internat. Monatsschr. f. Anat. u. Phys.*, XVI, 155, 177, 1899.

<sup>7</sup>Laguesse. *Sur les principaux stades du développement histologique du pancreas*. *Verhandlungen der anat. Gesellsch.*, 1897, 43.

spleen. Schäfer<sup>8</sup> thinks that they are similar to the small ductless structures, the carotid and coecal glands and the parathyroid bodies which are like them composed of anastomosing columns of epithelial-like cells, between which is a network of delicate tortuous capillaries.

Laguesse<sup>9</sup> has suggested that these structures represent a stage in the development of the glandular acini but has subsequently abandoned this view, in support of which there is no evidence. A number of observers have emphasized the supposed resemblance of the interacinar islets to lymphoid tissue. Renaut<sup>10</sup> has described the pancreas as a lympho-glandular organ composed, he conceives, of glandular structures and lymphoid tissue in intimate relation. He describes the cell groups as "points folliculaires," in which cells of a glandular type are situated in the meshes a reticular tissue. Mouret<sup>11</sup> has supported Renaut's somewhat ill-defined conception of a lympho-glandular organ, but has regarded the cell group as small masses of lymphoid tissue. Kühne and Lea and Dieckhoff<sup>12</sup> think it probable that they are small lymph follicles. Schlesinger<sup>13</sup> regards them as a variety of lymph follicle whose cells differ from those of ordinary lymphoid tissue. Podwysotski calls them pseudo-follicles and states that though they resemble lymph follicles their cells have nothing in common with lymphoid cells.

The only attempt to investigate experimentally the nature of the islands of Langerhans has been made by Lewaschew,<sup>14</sup> working in Heidenhain's laboratory. He studied the pancreas of dogs and cats, killed after having been subjected to conditions which cause the gland to secrete actively. After prolonged overfeeding or after the administration of pilocarpin, which stimulates the pancreas as it does the salivary glands, he claims to have found structures representing transitions between the gland acini and the interacinar cell group. He observes acini containing one or more cells whose protoplasm is non-granular and stains lightly. A whole acinus or a number of acini may be composed of such cells. In such areas some of the cells may assume a polygonal shape and are no longer grouped to form a central lumen. Other cell groups consist entirely of polygonal cells without acinar arrangement, and these represent, he thinks, the fully formed islands of Langerhans.

In order to obtain a large increase in the number of altered acini one even maximal stimulation of the gland is not suffi-

cient, but by the repeated administration of pilocarpin this result is accomplished and the longer and more intense the action of the drug the greater their number. To cause their increase by overfeeding a very large quantity of food is necessary. Lewaschew believes that the cells composing the interacinar groups may reassume the characters of secreting cells and again form acini. He mentions that he has found an unusual number of islands under conditions other than those of increased functional activity. They were very numerous in a dog which several days before its death had suffered with fever.

The observations of Lewaschew have not been confirmed. In the human pancreas one occasionally finds altered glandular cells. Non-granular refractive cells may occur in otherwise normal acini and entire acini or groups of acini may be composed of such cells. Laguesse,<sup>15</sup> regarding them as transitions between acini and interacinar groups, has adopted the view of Lewaschew.

It is by no means surprising that little is known concerning the function of structures whose nature is so little understood. Laguesse<sup>16</sup> thinks that they represent secreting acini temporarily modified to adapt themselves to a new function, the elaboration of an internal secretion. Schäfer<sup>17</sup> and Diamare think that the vascular islets probably furnish an internal secretion. The only evidence in support of this suggestion is contained in the short preliminary notice of Ssoblew.<sup>18</sup> He states that after feeding animals on carbohydrates the cells of the islands become more granular. After ligating the duct of Wirsung in dogs the islands of Langerhans, he finds, are not involved in the sclerotic process which follows. He thinks that this fact explains the absence of glycosuria after ligation of the pancreatic ducts. In human cases I had observed after duct obstruction<sup>19</sup> similar resistance of the islands to the consequent inflammation. In pancreas of two diabetics Ssoblew was unable to discover islands of Langerhans.

I have attempted to determine the relation of the islands of Langerhans to the other elements of the pancreas. They have been observed in human cases under a great variety of conditions, in cats and in dogs. Their relation to the blood-vessels has been studied in injected specimens. Finally, I have attempted to repeat the experiments of Lewaschew in order to test the possibility of transforming acini into interacinar cell islets.

In the human pancreas the islands were found to be more numerous in the splenic end or tail than elsewhere. To obtain a numerical statement of their relative abundance, their num-

<sup>8</sup> Schäfer. Quain's Anatomy, Vol. III, Pt. IV, p. 318.

<sup>9</sup> Laguesse. Sur la formation des îlots de Langerhans dans le pancréas. Compt. rend. Soc. de biol., 9. S., V. 819, 1893.

<sup>10</sup> Renaut. Loc. cit.

<sup>11</sup> Mouret. Tissue lymphoïde du pancréas et cellule centro-acineuse. Compt. rend. Soc. de biol., 10. S. I., 731, 1894.

<sup>12</sup> Dieckhoff. Beiträge zur pathologischen Anatomie des Pankreas. Festschrift f. Thierfelder, Leipzig, 1895.

<sup>13</sup> Schlesinger. Die Erkrankung des Pankreas bei hereditärer Lues. Virch. Arch., CLIV, 501, 1898.

<sup>14</sup> Lewaschew. Ueber eine eigenthümliche Veränderung der Pankreaszellen warmblütiger Thiere bei starker Absonderungsthätigkeit der Drüse. Arch. f. mikros. Anat., XXIV, 452, 1886.

<sup>15</sup> Laguesse. Sur quelques détails de structure du pancréas humain. Compt. rend. Soc. de biol. S. 10., I, 667, 1894.

<sup>16</sup> Laguesse. Compt. rend. Soc. de biol., 9. S., V, 819, 1893.

<sup>17</sup> Schäfer. Internal Secretions. Lancet, 1895, II, 321.

<sup>18</sup> Ssoblew. Ueber die Structure der Bauchspeicheldrüse unter gewissen pathologischen Bedingungen. Centralbl. f. allg. Path. u. path. Anat., XI, 202, 1900.

<sup>19</sup> Opie. Pathological Changes Affecting the Islands of Langerhans of the Pancreas. Jour. Boston Soc. Med. Sciences, IV, 251, 1900.

ber was determined in a sectional area of 0.5 square centimetre. Sections about 10  $\mu$  thick were made from the enlarged duodenal portion of the pancreas or the head, from the mid-portion or body and from the splenic end or tail. The following table gives their number in an area of 0.5 square centimetre in sections taken from the head, body and tail of ten normal organs:

TABLE I.

	Head.	Body.	Tail.
I.....	11	13	20
II.....	30	25	42
III.....	4	4	19
IV.....	4	10	13
V.....	27	18	59
VI.....	25	27	26
VII.....	18	18	29
VIII.....	6	10	29
IX.....	44	32	61
X.....	14	23	32
Average.....	18.3	18.0	34.0

The table shows that the islands are more abundant in the tail or splenic end than in the head and in the body, where they are present in approximately equal number. They are almost twice as numerous in sections from the tail as in those from other parts. Since the number in only one plane is recorded, in order to obtain their actual relative abundance it is necessary to square these figures. They are then found to be slightly less than three and a half times as numerous in the tail as elsewhere.

The islands of Langerhans are more numerous, as pointed out by Kasahara,<sup>20</sup> in the pancreatic tissue of the fetus and of very young children than in that of the adult. Should we assume that they are formed during embryological development and persist thereafter, this fact is readily explicable. The organ being much smaller in the fetus and in the young child, the same number of islands, though themselves smaller, are closer together and therefore appear to be more numerous in sections.

The cells composing the islands resemble those of the acini. They have a large round, occasionally oval, vesicular nucleus and a conspicuous cell body. The basal zone of the secreting cell, as is well known, stains deeply with nuclear dyes, for example, hamatoxylin or methylene-blue, while the central portion which contains zymogen granules remains unstained. The cells of the island, however, do not stain with nuclear dyes, while with eosin their protoplasm takes a homogeneous bright pink color. The nuclei differ but little from those of neighboring acini. They vary considerably in size and not infrequently one finds very large round vesicular nuclei whose diameter is two or more times that of those about. Occasionally the cells, forming columns between which are the anastomosing capillaries, are very closely packed together and

nuclei are situated almost side by side; more frequently the cells of the island are less numerous and the nuclei are less closely crowded together.

The outline of the island is usually round or oval and is not infrequently accentuated by a delicate circle of fibrous tissue. In other instances the outline is less sharp and the body accommodates its shape to that of the neighboring acini. Occasionally one sees, apparently within the island, cells arranged, as in the acini, about a central lumen and, indeed, in many instances it is difficult to convince one's self that they do not form part of it. The impression is produced that the columns of the island are in continuity with cells having an acinar arrangement. Since the islands and the secreting acini have a common origin it is not inconceivable that they may occasionally remain continuous in the adult organ. When the fetal pancreas is affected by congenital syphilis, the islands, I have found,<sup>21</sup> retain their continuity with the secreting structures.

In the human pancreas the groups of acini about terminal ducts are not sharply defined by connective tissue, so that individual lobules, as in the human liver, are indistinctly marked off and in places apparently fuse with one another. In the pancreas of the cat the lobules, like those in the liver of the pig, are much more sharply outlined by interstitial tissue. Details of structure have been studied in the pancreas of the cat.

The parenchyma is divided by septa of fibrous tissue into small polygonal areas varying in size and shape. When injected with Berlin-blue a small ramification of the ducts is found to penetrate the isolated group of acini. These subdivisions or lobules often appear completely isolated by fibrous tissue from those nearby, but when one of them is traced through a series of sections its separation may not be uniform and in places one finds the parenchyma of adjacent lobules in contact, the dividing septa being incomplete. That these polygonal structures are actually independent of one another and represent units of structure is readily demonstrated by causing an inflammatory increase of the interstitial tissue. If the pancreatic ducts of a cat are ligated and the animal killed at the end of two or three weeks, the gland is found to be the seat of a chronic interstitial inflammation, characterized by an increase of the interlobular tissue. The lobules are completely separated from one another by narrow bands of firm fibrous tissue and occur in sections as rounded triangular or polygonal areas of parenchyma.

The islands of Langerhans occupy a position near the centre of the lobule and in the splenic end of the gland each lobule contains an island. In a given section many lobules whose limits are more or less distinctly outlined are seen to contain islands situated near their centre, while in neighboring lobules such structures may not be discoverable. If, however, serial sections are studied every lobule is found to contain an island. Its presence within the lobule is not constant in other parts of the organ, and in the extremity

<sup>20</sup> Kasahara. Ueber das Bindegewebe des Pankreas bei verschiedenen Krankheiten. Virch. Arch., CXLIII, 111, 1896.

<sup>21</sup> Opie. Loc. cit.



of the descending arm of the gland they are very few in number.

The lobules are grouped about the medium sized ducts. The main ducts give off branches approximately at right angles to their course. Branching one or more times a duct forms the centre of a group of lobules, which is usually elongated in form and tapers to a point at or near the surface of the gland. Such lobule groups are separated from one another by relatively wide bands of areolar tissue much looser in texture than that separating the individual lobules. The lobule groups in the fresh state or in tissue macerated a few

of dilated capillaries but numerous anastomoses make it continuous with the interacinar capillaries. When Berlin-blue is injected through the aorta into the arteries of the pancreas, it not infrequently happens that in portions of the gland which are poorly injected the vessels of the island are filled with the injected mass, while the surrounding capillaries are for the most part empty. If instead of soluble Berlin-blue a granular injection mass, for example, cinnabar or ultramarine blue is used, the islands may be injected while the interacinar capillaries contain little of the injected material. The glomerular network is in very free communication with the smallest arteries and apparently has a richer blood supply than other parts of the lobule.

In the human pancreas lobules and lobule groups are not so regularly arranged as in the cat. But both structures are more or less clearly definable. The lobules vary much in size and are usually not clearly separated from one another. Though an island of Langerhans is often situated in the centre of a more or less clearly defined lobule, no constancy of position is discoverable. The lobule groups are separated by relatively wide bands of loose areolar tissue in which are contained the medium sized ducts, the blood-vessels and the nerves. Within the lobule group the arteries and veins which are side by side do not, as in the cat, accompany the ducts.

In the normal human pancreas one occasionally finds small groups of acini composed of cells differing from the typical glandular type and suggesting a transition from the secreting cell to that of the island of Langerhans. The cell-protoplasm does not take the nuclear dye as does the basal portion of the ordinary glandular cell, and when stained with eosin has a bright pink color and homogeneous refractive appearance. The nucleus, which shows no evidence of degenerative change, is situated near the centre of the cell. Occasionally one or more cells of the character described form part of an acinus which otherwise resembles those about it. Usually, however, a group of acini are changed, and such an area often corresponds in size to an island of Langerhans.

The presence of altered acini whose cells resemble those of the island confirms at first sight the view of Lewaschew that groups of acini may assume the characters of the inter-acinar structures. It is probable that such foci in part at least represent what Laguesse<sup>22</sup> and Pischinger<sup>23</sup> have described as stages of transition. The arrangement of more or less columnar cells about a central lumen is, however, still preserved and one does not find similar areas in which this arrangement is lost. The lumen, indeed, is usually very conspicuous and is often considerably dilated, filled with products of secretion which stain deeply with eosin. It seems probable that these groups of acini are altered as the result of peculiar functional activity, it may be, of hyperstimulation of the gland. There is at least no evidence that they represent

<sup>22</sup> Laguesse. *Compt. rend.*, S. 10, I, 667, 1894.

<sup>23</sup> Pischinger. *Beiträge zur Kenntniss des Pankreas. Inaug.-Diss., München, 1895.*



Fig. 1

FIGURE 1.—Camera lucida tracing of the lobule boundaries in one of a series of sections from the splenic end of a cat's pancreas. The majority of the lobules are well defined. Those marked *d*, *e*, *f*, *g* and *h* are poorly outlined but are found to be more readily distinguishable when traced through the series of sections. The lobules, which are lettered (*a* to *o*), were traced through the series and each was found to contain an island of Langerhans situated near its centre. The section passes through the island in lobules *a*, *c*, *i*, *l* and *n*.

days in Müller's fluid may be separated from one another by careful teasing. In the loose tissue lie the larger ducts, arteries, veins, and nerves. An artery and vein penetrate each lobule group in company with the duct and ramify between its lobules. The smallest arteries occasionally penetrate the lobules, but usually branches, diminishing in size, give off capillaries which enter the lobule and form a close network between the gland acini.

The capillaries of the island of Langerhans form a glomerulus of tortuous freely anastomosing vessels, much thicker than those between the acini. A single afferent vessel like that of the glomerulus of the kidney does not enter this group

transitional stages between gland acini and islands of Langerhans.

Such altered acini are observed in a small proportion of normal glands. They were found in three of twenty-seven glands examined carefully for their presence. They were present in three of seven relatively normal organs from diabetic patients. The occurrence of voracious appetite and increased food ingestion in individuals so affected may explain the occurrence of these areas which represent possibly foci of peculiar secretory activity. They were particularly abundant in one instance of chronic interstitial pancreatitis not associated with diabetes.

Lewaschew has claimed that he was able to transform groups of secreting acini into islands of Langerhans by stimulating the pancreas with pilocarpin. A single administration of the drug does not suffice, but by its repeated administration an undoubted increase in the number of islands may, he says, be obtained. Under such conditions these bodies appeared to be more numerous than usual, but he has made no attempt to determine their actual number. He does not record the amount of pilocarpin used nor the frequency of its administration. His experiments have not been repeated.

I have attempted to confirm the observations of Lewaschew by injecting subcutaneously pilocarpin muriate into dogs. Since the number of islands was found to vary in different parts of the gland, it was considered desirable to study sections from corresponding parts of the organ. Specimens were prepared from (a) the splenic extremity, from (b) the portion which is in contact with the duodenum, and from (c) the descending portion which lies in the mesentery of the duodenum. In order to determine with accuracy the relative abundance of the islands their number was counted in a measured sectional area and compared with that found in the pancreas of an animal to which pilocarpin had not been given.

Following is a summary of the experiments performed:

*Dog No. 1.*—The animal was given daily for nine successive days 0.02 to 0.03 grm. of pilocarpin muriate. Profuse salivation was produced often with vomiting and diarrhœa.

*Dog No. 2.*—During twenty-eight hours pilocarpin muriate

0.005 to 0.01 grm. was injected subcutaneously six times. The drug produced profuse flow of saliva.

*Dog No. 3.*—During twenty-four hours pilocarpin muriate 0.01 grm. was injected subcutaneously seven times. Profuse salivation followed each injection.

In the table the figures represent the number of islands in 0.5 square centimetre of sectional area. The letters refer to the parts of the gland indicated above.

TABLE II.

Injected animal.	a.	b.	c.	Control animal.	a.	b.	c.
Dog No. 1. . . .	61	21	1	Dog No. I . . .	59	61	14
No. 2. . . .	55	20	11	No. II. . . .	39	53	3
No. 3. . . .	54	72	8	No. III. . . .	67	89	12
Average . . . .	56.6	37.6	6.6	Average . . . .	55.	67.6	9.6

The figures show that no increase of the number of islands was obtained in the three experiments. Transitional stages between glandular acini and interacinar islets were not observed. The number of islands in that part of the descending portion of the pancreas which lies in the mesentery of the duodenum (c) is constantly much less than elsewhere. The number in different glands and in different parts of the same gland varies considerably. In the experiments of Lewaschew these sources of error have apparently not been given sufficient weight.

## CONCLUSIONS.

(1) The islands of Langerhans are composed of cells having the same origin as those of the glandular acini but forming structures which are independent of the secreting apparatus and in intimate relation with the vascular system.

(2) In the splenic end of the cat's pancreas they have a definite position within the lobule, each of which contains one of these structures.

(3) In the human pancreas they are more numerous in the splenic extremity or tail than elsewhere. Similar variation in their number is observed in cats and dogs.

(4) Prolonged stimulation of the gland does not, as claimed by Lewaschew, transform groups of acini into islands of Langerhans.

## THE DISTRIBUTION OF CONNECTIVE TISSUE IN NEW GROWTHS.

BY W. C. WHITE, M.B.

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I here report the result of the study of the distribution of connective tissues (viz., yellow elastic tissue, white fibrous tissue and reticulum) in seventeen new growths, obtained in the fresh state from the Surgical and Gynecological Department of the Johns Hopkins Hospital through the kindness of Dr. Cushing and Dr. Kelly.

The work was done in the Pathological Laboratory of the Hospital at the suggestion of Dr. L. F. Barker, and I am

much indebted to him for his willing and valued assistance throughout. To Dr. F. P. Mall I am also under obligations for many kind suggestions.

The following methods were employed:

1. For the study of elastic tissue.

(a) Demidessication and artificial œdema; fresh tissue stained with magenta.

(b) Weigert's<sup>1</sup> elastic fibre staining of the hardened tissue.

(c) Unna's orcein stain (hardened tissue).

2. For the study of white fibrous tissue and reticulum.

(a) Mall's method.<sup>2</sup> Digesting the fresh frozen section in pancreatin solution.

(b) Spalteholz' method.<sup>3</sup> Digesting sections of hardened tissues in pancreatin solution, alternate sections being stained with hematoxylin and eosin for comparison.

(c) Van Gieson's picric acid fuchsin stain.

(d) Mallory's new connective tissue stain, the use of which was very kindly permitted by Dr. Mallory, although the formula is still unpublished.

In studying the distribution of these tissues it has been taken for granted (1) that the tissue staining purplish with magenta in the fresh preparations and deep blue with Weigert's stain in the hardened preparation is elastic tissue, and (2) that the tissue left after digestion in pancreatin solution and staining red with Van Gieson's stain and blue with Mallory's stain is either white fibrous tissue or reticulum, and I have called them such in writing this paper.

The object has been, not to study the distribution of one kind of connective tissue, but to study the character and distribution of the several kinds by many methods.

It has been a great drawback that there is as yet no certain method of distinguishing white fibrous tissue and reticulum. Siegfried<sup>4</sup> has found in reticulum a substance which he calls reticulin, thus distinguishing it from white fibrous tissue which yields gelatine, but this method was not practically applicable in the present study. Then certain structural differences, it is asserted, exist between the two substances; viz., the wavy more or less parallel fibrils of white fibrous tissue running in bundles as against the very fine anastomosing and branching fibrils of reticulum; but the two substances are so intimately associated in any structure that the question arises of the possibility of the one being the final breaking up and division of the other.

In the sarcomata and myomata reticular networks were found which in structure coincided with reticulum, the fibrils definitely branching and anastomosing, but they were here intimately associated with bundles of wavy parallel fibres which were just as typical of white fibrous tissue. In some places this reticular network appeared to have its origin from these bundles, while in other cases it seemed only to gain an anchorage there, the fibrils extending only for a short distance among the fibres of the bundles. In other places, and this was very frequent in the sarcoma sections studied by Mall's method, the fibrils of the reticular network appeared to arise from certain focal points suggesting the possibility of their being the processes of cells which had been digested away, but the most probable explanation of this appearance was to

be found in the thickness of the sections, several fibrils overlying one another at certain points. Again, the fibrils which presented the structural characters of white fibrous tissue were frequently seen in the Mall preparations to break up into much finer fibrils, suggesting the possibility of the two substances, white fibrous tissue and reticulum, being the same substance, the latter being the final division of the former.

So that without some method of determining the distinction or relation between the two substances the description of what was found in the present study has necessarily been purely objective, the two substances being included under the one head. Still some endeavor was made to discover the relation after pancreatin digestion of what was found in myomata to tendon and also to reticulum by the following methods suggested by Dr. Mall.

Tendon was obtained from the human tendo-achillis. Reticulum was obtained from the gut of a dog by drawing the small intestine between the handles of a pair of scissors and thus removing the muscular coats and mucous membrane, leaving only the submucosa. A myoma was secured after removal from the human uterus. Small sections of all three were cut and digested in pancreatin solution.<sup>5</sup>

They were then thoroughly washed in water and later placed in test tubes containing (1)  $\frac{1}{2}$  per cent hydrochloric acid; (2) 1 per cent hydrochloric acid; (3) 1 per cent solution of caustic potash and immersed in a beaker of boiling water and the results tabulated.

I have given also by permission the tables of Dr. Mall<sup>6</sup> and of Dr. Flint.<sup>7</sup>

TABLES.

## DR. MALL'S TABLE.

	Time taken to dissolve tendon.	Time taken to dissolve reticulum.
Boiling KOH 1% . . . . .	30 seconds.	1.5 minutes.
Boiling HCl $\frac{1}{2}$ % . . . . .	1 minute.	18 minutes.
Tissues remaining in the solution one hour before boiling.		

## DR. FLINT'S TABLE.

Solution.	Time required to dissolve.		
	Tendon.	Adrenal reticulum.	Lymph gland reticulum.
HCl 0.5% . . . . .	3 $\frac{1}{2}$ mins.	10 mins.	11 $\frac{1}{2}$ mins.
KOH 0.13% . . . . .	3 mins.	14 $\frac{1}{2}$ mins.	22 mins.

In Dr. Flint's work the sections remained in the solutions two hours before boiling, and at the end of the time given the tendon was completely dissolved and the solutions clear, while the reticulum in each case remained as a granular detritus even after boiling for thirty-five minutes.

Time required to dissolve

Solution.	Tendon.	Reticulum.	Myoma.
Boiling HCl 1.5% . . . . .	27 mins.	43 mins.	55 mins.
" HCl 1% . . . . .	12 mins.	22 mins.	27 mins.
" KOH 1% . . . . .	27 mins.	29 mins.	30 mins.

At the end of the different times given the tendon in each

<sup>1</sup> Centralbl. f. alg. Path. u. path. Anat. IX, 1899.

<sup>2</sup> Johns Hopkins Hospital Reports, Vol. I, 1896.

<sup>3</sup> Archiv f. Anat. u. Phys., Anat. Abth., 1897, Supp. Bd.

<sup>4</sup> Habilitationsschrift, Leipzig, 1892.

<sup>5</sup> Pancreatin (P. D. & Co.), 5 grm.; sodium bicarbonate, 10 grm.; water, 100 cc.

<sup>6</sup> Loc. cit.

<sup>7</sup> The Blood Vessels of the Adrenal. Contributions to the Science of Medicine. Dedicated to Wm. H. Welch, Baltimore, 1900.



case was completely dissolved and the fluid remained quite clear, but in the case of both the reticulum and the myoma there remained a minute granular detritus in a very cloudy or turbid fluid. The appearance of tendon was also quite different both from the myoma and the reticulum, which two latter substances behaved very similarly. The edges of the tendon section within a few minutes became very much swollen and assumed a gelatinous or translucent appearance, and this gelatinous area increased at the expense of an opaque centre, but at the same time dissolved away until all had passed into solution. The myoma and reticulum, on the other hand, became shreddy and granular in appearance and gradually broke up into very minute granules which remained suspended in the fluid. In the myoma in the 1 per cent hydrochloric acid solution it was noticed at the end of four minutes that there appeared some swelling and translucency at spots on the surface, but this had all disappeared at the end of ten minutes and after this it behaved very similarly to reticulum. A longer time was taken to accomplish the solution than in the other two tables, but this was probably due to the larger sections used. In the latter cases frozen sections were used, while in this work the pieces measured probably .5 cm. square. In the caustic potash experiment the section of tendon was somewhat larger than the other two sections.

Also based upon Mall's<sup>8</sup> finding that tendon is much more quickly dissolved in pepsin solution than either reticulum or yellow elastic tissue, several frozen sections of myoma were digested for twenty-four hours in pancreatic solution, then washed in water and subsequently put in pepsin solution in the thermostat and removed at different times, 5, 10, 15 and 30 minutes. Mall found that tendon was completely dissolved in a strong solution of P. D. & Co.'s pepsin in from 5 to 30 minutes, while elastic tissue and reticulum only begin to be dissolved at the end of this time. In these sections all evidence of structure was lost, even at the end of five minutes, but at the end of thirty minutes a considerable portion, possibly amounting to one-third of the original section was removed upon the slide. This experiment, however, loses much in value from the fact that no control specimens of either tendon or reticulum were made.

Regarding the two methods of studying white fibrous tissue and reticulum by digestion, viz., that of Mall and that of Spalteholz, each one gives evidence of value that is not obtained from the other, and as Flint says, both should be used together since in Mall's method owing to the thinness of the section a suggestion of a third dimension is obtained and the fibrils may be traced in most cases throughout their entire course. On the other hand, of the relation of the connective tissue to the cells of the growth very little can be studied owing both to the spreading of the section in mounting and to the difficulty in obtaining a near control section.

In Spalteholz's method, however, since alternate sections are easily obtained, one being digested and the other stained

intact, the relation of cells and connective tissue is readily studied, but owing to the thinness of the section the fibrils are cut short and in many cases appear only as minute spindlar forms, it not being possible to follow their course for any distance.

The subject of elastic tissue in new growths has received a number of contributions since the publication of Weigert's elastic fibre stain.

Melnikow Raswedenkow in Ziegler's Beiträge, Bd. 26, 1899, has described the distribution of elastic tissue in various organs in normal and pathological conditions, and states that elastic fibres in healthy and diseased tissues are derived mainly from the vascular walls, and further that in tumors no new formation of elastic tissue occurs. In the discussion on the paper, however, in the German Pathological Society in Munich, a number of observers reported cases where an increase in amount was present. Hansemann reported a large increase of elastin in a case of metastatic tumor in the spleen but had not found any, as a rule, in malignant growths. Schmorl reported a case where numerous elastic fibres were found in a carcinoma of the stomach. Orth and Nauberek found in carcinomata cases very many elastic fibres present.

Alice Hamilton<sup>9</sup> has reported a case of fibro-sarcoma of the brain in which there was a very large amount of elastic tissue present; the tumor presented a very peculiar rosette arrangement and in places masses of considerable size surrounding blood-vessels, all of which masses were of a fibrillar nature, but elastic tissue was also present as wavy fibrils running among the cells without any apparent relation to a vessel wall or to the cells of the growth. She agrees with Melnikow Raswedenkow as to the origin of elastic fibres from vessel walls but contradicts his statement that in tumors no new formation of elastic tissue occurs. In this case the amount was much more than normal, but the relation was frequently to the periphery of the vessel wall, and where this relation was not found, the presence of elastic tissue was ascribed to the obliteration of the vessel or to the severance of the original connection of the fibres.

H. W. Williams,<sup>10</sup> in a paper on the new formation of elastic fibres, gives a report of his study of 37 cases of carcinoma; 12 in the liver, 4 in lymph nodes, 2 in the thoracic duct, 2 in large veins, 2 in the cerebrum, 1 in the lung, 8 in the mammae, 1 in the skin, 1 in the stomach and 1 in the rectum. The following are his conclusions:

1. When the stroma of a carcinoma is itself of new formation it is usually free from elastic fibres.
2. Newly formed elastic fibres may occur in the stroma through rarely, and they are likely to be fine in quality and small in number.
3. The tumors in which newly formed elastic fibres occurred either contained a large amount of connective tissue

<sup>8</sup> Centralbl. f. alg. Path. u. path. Anat., X, 832.

<sup>9</sup> Jour. of Exp. Med., Vol. IV, No. 5 and 6, 1899.

<sup>10</sup> Contribution to the Science of Medicine. Dedicated to Wm. H. Welch. Baltimore, 1900.

<sup>7</sup> Johns Hopkins Hospital Reports, Vol. I, 1896, 1897, 1898, 1899, Tissue.

troma or the newly-formed fibres were in connection with pre-existing elastic elements of the original parts.

He found evidence of new formation in three cases of carcinoma of the liver. In carcinomata of lymph nodes the structure was usually free from elastic tissue and when present it was not possible to demonstrate its new formation. In one carcinoma of the thoracic duct there was new formation and in two of the venous growths. In two of the cerebral cases, one secondary from an adeno-carcinoma of the lung and one secondary from the stomach, there were fine elastic fibres present possibly connected with some prolongation of the pia mater. In the carcinomata of the mamma nothing was seen to prove new formation.

Kronmayer found in rapidly-growing condylomata, warts and carcinomata of the skin no newly-formed elastic fibres. These were present, however, in older papillomata and fibromata.

There are also a considerable number of papers on the new formation of elastic tissue in other pathological conditions, to which reference will be found in Dr. Williams' paper."

In seven of the seventeen cases in the series here reported, elastic fibres were found, the description of which will be found under the individual cases. In all cases they apparently had their origin from the vessel walls. In only one case, No. 6, a carcinoma of the breast does there seem to be sufficient ground for claiming an increase in amount or a new formation. The sections from this case were compared with those from three normal breasts and three other carcinomata and contained a much greater amount of elastic tissue than any of the others.

The safest method of judging the amount of new formation if such exists in any case would seem to be that of comparison of sections of the growth with sections of the normal tissue in which the growth was situated. This, unfortunately, was only done in one case (case 18). In this case a portion of the normal breast in which the carcinoma had grown was prepared in the same way as the growth itself. A description of the comparison will be found under this case.

Regarding the origin and normal development of elastic fibres whether from the transformation of cells, by fusion, into fibres or from the transformation of the intercellular matrix there is still no satisfactory answer.

On the subject of the study of tumors by digestion methods no literature was to be found.

#### DESCRIPTION OF INDIVIDUAL CASES.

Specimens Nos. 1, 4 and 8. Fibromyomata of the uterus.

*Elastic Tissue.*—In these cases there were no elastic fibres found either in the fresh preparations or in the hardened sections stained with Weigert's elastic fibre stain.

Monatsschrift f. prakt. Dermatologie, Bd. XIX.

*White Fibrous Tissue and Reticulum.*—To the naked eye these sections gave the appearance of a fibrillary structure and under the dissecting microscope the fibrillary nature was more clearly seen. The tissue remaining after digestion was collected in places in thick masses and strands, from both of which branches were given off and these again branched in turn. The thicker strands presented in places a distinct whorled appearance, and between the masses and strands minute wavy fibrils were seen running in a more or less parallel direction and passing into and becoming continuous at either end with the thicker portions of the section.

Under the low power of the microscope the masses formed nodal points from which prolongations were given off, an infinite number of very fine fibrils appearing in places.

The larger strands were composed of minute fibres in very close apposition to one another. These strands divided and united again and gave off branches, and from these branches

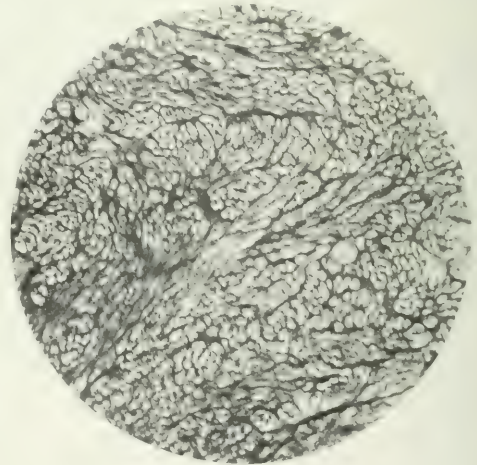


FIG. 1.—Section of a fibromyoma digested by Spalteholz' method, showing the bundles of white fibrous tissue and the reticular network in the meshes of which the muscle cells lay.

and from the sides of the strands themselves there arose exceedingly minute, very wavy, interlacing fibrils running in a course more or less parallel to one another, and in some places arising from one strand and passing into and becoming lost in another strand.

In other parts of the section between the strands was seen a very fine network similar to that obtained by Spalteholz' method to be described later.

With the high power the fibrillary nature was more clearly seen in some parts, the fibrils being very wavy, in others quite straight throughout their course. The strands themselves were composed of the wavy interlacing fibres of white fibrous tissue while the minute network presented very much the ap-

pearance of reticulum except that in these sections no definite anastomosis was observed.

In the preparations by Spalteholz' method very little could be made out either with the naked eye or with the dissecting microscope, but with the latter very minute apertures throughout the section were plainly seen.

Under the low power, however, the condition described under the Van Gieson and Mallory preparations is very clearly seen; viz., a connective-tissue envelope for each muscle-cell.

The connective tissue was very abundant and formed by far the major portion of the section. It was arranged in two ways.

1. Running in every direction and forming a large irregular network, leaving meshes of varying size, were large strands composed of wavy interlacing fibres which followed a more or less parallel course. In places these strands divide and unite again, leaving spaces which are occupied by the network to be described later. In the midst of these strands are seen also the apertures of blood-vessels surrounded by denser tissue, the size of the vessel varying with the size of the strand.

2. In the meshes formed by this stroma was found a minute network apparently formed by the division, subdivision and anastomosis of the branches of this stroma proceeding from all sides of it as it surrounded the individual spaces. The minute meshes of this second network are filled in the control specimen with single muscle cells.

*Van Gieson Preparation.*—To the naked eye the general impression of this section was red, but on holding it up to the light areas having a yellowish tint were seen. These varied in size and were surrounded by a capsule of deep red. Besides these areas there were certain parts of the section of a lighter and apparently uniform red color, intimately connected with the capsules of the yellowish areas. The capsules surrounding the yellowish areas formed an irregular network throughout the remainder of the section.

With the dissecting microscope the darker capsules mentioned above were seen to run through the section looking like an injected vascular network. The branches from this network ran into and divided the yellowish areas which they surrounded into still smaller areas.

The lighter reddish masses seen with the naked eye were here not so uniform in color, but appeared as a very close network of red stained tissue, and held in the meshes of this network were yellowish cell bodies similar to those found in the other areas, but here the red stained material was much more abundant, the strands being thicker and the meshes smaller.

The general network of red stained connective tissue was irregular, the meshes varying in size, the larger bundles of red surrounding the larger yellowish areas and branches from these forming the walls of smaller areas, but even in the larger strands of red, small groups of yellowish cells were constantly seen.

With the low power the uniform reddish masses were seen to be composed of a dense network of comparatively thick strands of red with small meshes containing the yellowish

cell bodies. These yellowish cells were evidently the muscle cells and will be so called in the further description.

The general network of red could be traced with this power to much smaller divisions, in some cases the branching and anastomosing forming so small a network that the meshes of the same contained only a single muscle cell.

The larger strands of red-stained connective tissue had in places a definite whorled appearance and throughout their substance were seen scattered the connective-tissue corpuscles. In these strands were also seen numerous blood-vessels, the larger ones occurring in the larger strands and so on. The muscle cells of the walls of these vessels were stained yellow, similarly to those contained in the general network.

Under the high power the network of connective tissue could be traced to still finer divisions, so that each muscle cell was here seen to have an enveloping capsule of its own, very fine in most instances but comparatively thick in others. In the midst of the larger strands occasional muscle cells were also present.

Mallory's stain gave a very similar picture to that obtained by Van Gieson's stain.

Specimen No. 2 was from a sarcoma of the uterus, but contained so small a portion of sarcomatous tissue that it was of very little service for study; still in the Spalteholz preparation a reticular network similar to that found in other sarcomata was demonstrated in one portion of the section.

Specimen No. 3 was a portion of the wall of a multilocular ovarian cyst and showed only a dense white fibrous tissue structure in which no elastic fibres were found.

Specimen No. 5 was an epithelioma of the inferior maxilla. This growth was of five and one-half years' duration, but for one year previous to its removal had grown very rapidly. It involved the whole depth of the left half of the inferior maxilla from the ramus behind to a point 2 to 3 cm. beyond the middle line in front. It presented a lobulated appearance with a reddish surface looking like granulation tissue and had an actively growing appearance.

No elastic tissue was found by either method except around the vessels.

Mall's preparation was very unsatisfactory for study; the connective tissue remains forming a more or less solid mass, from which nothing but a fibrillary construction could be made out.

Spalteholz' method showed a distribution of connective tissue similar to that described below under Mallory's stain the parts of the control section occupied by the large irregular masses of cells being in the digested specimen quite devoid of connective tissue.

The section stained by Mallory's stain gave in this case the best idea of the distribution of the white fibrous tissue, its absence in the cellular areas and its distribution being controlled by the Spalteholz' preparation.

The ground work of the section was made up of extensive



strands and bay-like processes of epithelial cells joined together by their minute protoplasmic processes which were very plainly visible and appeared in places as a reticular network; of this, however, nothing remained after digestion. These strands of cells formed a connected network but in certain places became condensed, lying much closer together in rows surrounding larger and smaller irregular spaces which contained a fine loose network of connective tissue, holding in its meshes numbers of connective-tissue corpuscles and polymorphonuclear cells.

The connective tissue in these spaces was collected in the centre into bundles and masses of wavy fibres, and from these minute fibrils radiated outward in all directions as an exceedingly minute fibrillary network, becoming gradually looser in texture until at the edge just inside of the rows of cells they curved and formed an interlacing ring of tissue which, however, sent no processes among the cells of the growth. This latter condition was only demonstrated by the Spalteholz' preparation.

In several of these spaces there were also seen small blood-vessels swing in the network.

Besides the connective tissue in these spaces there were several strands of white fibrous tissue fibrils which divided the section into smaller portions, but had not been invaded by epithelial cells. These strands were evidently the origin of the connective tissue in the spaces, as many of the latter were found continuous with the former. The connective tissue in the isolated spaces had apparently been shut off by the invasion of the epithelial cells and had then commenced to throw out new fibrils, for in these spaces the connective tissue corpuscles were in a very actively multiplying condition, the nuclei dividing and undergoing mitotic changes.

The larger strands carried in their substance several large blood-vessels. In one or two places in the sections areas of degeneration were present filled with granular debris and polymorphonuclear cells, and around these areas, extending for some distance among the surrounding cells, many polymorphonuclear cells were to be found.

Specimen No. 6 was part of a carcinoma of the left breast in a woman 56 years of age. The growth was of one year's duration and at the time of removal measured 5.5 x 5 cm. Besides this larger nodule there was a second smaller growth 1.5 x 1.5 cm. in size. The nipple was slightly retracted and there were metastases in the cervical and axillary glands.

*Elastic Tissue.* The fresh tissue teased out upon a slide and stained with magenta showed a considerable number of purple stained elastic fibres varying in thickness, quite wavy and curled at their free ends.

The frozen section stained with magenta also showed elastic fibres around groups of cells and around the blood vessels and lymphatic ducts and also around all of the connective-tissue stroma.

In the preparation hardened in Zenker's solution and stained with Weigert's elastic fibre stain the sections presented, even to the naked eye, many of the same features, represent-

senting the elastic tissue. This was distributed throughout the section in two ways: (1) Surrounding certain definite areas and marking these off distinctly from the rest of the section. (2) As minute lines running for short distances through the balance of the section.

Under the low power the areas mentioned above were composed of the cells of the growth grouped together in varying numbers from 5 or 6 up to many hundreds, and immediately outside of these groups was an irregular or serrated encasement of elastic tissue in single and double layers, and outside of this again a layer of connective tissue in which were scattered many minute fibrils of elastic tissue. These were evidently the lactiferous tubules which had been invaded by the growth. Many elastic fibres were also present in the walls of the blood-vessels. There were also a number of very small areas containing only three or four cells which were com-

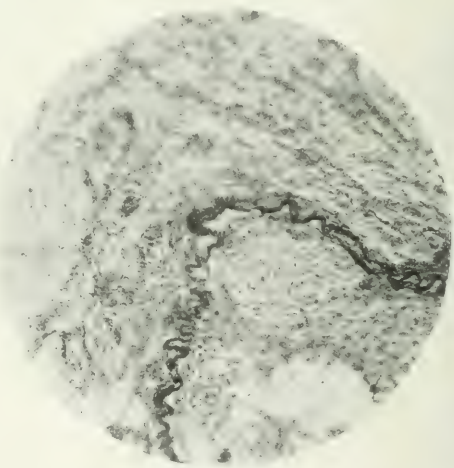


FIG. 2.—Section of carcinoma of breast No. 6, stained by Weigert's elastic fibre stain, showing the distribution of elastic tissue around a large nest of cells and in the surrounding stroma.

pletely surrounded with elastic tissue and in some places these areas themselves appeared in groups of three and four. Besides the above distribution there were also numbers of fibres of elastic tissue running in the connective tissue strands in double lines as if the remains of a vessel no longer patent. It was with the high power, however, that the very large amount of very fine elastic fibrils running through the sections could be made out following mainly the white fibrous-tissue framework but often seen among the cells of the growth with apparently no other connective tissue accompanying them.

Many of the groups of cells were quite devoid of elastic fibrils around them.

There was, apparently, an increase in the amount of elastic tissue in this growth, for in comparison with three normal

breasts two from cases younger than the patient from whom the present growth was removed,<sup>34</sup> and three other carcinomata of the mamma, this growth contained a very much larger amount than any of the others. There were also so many minute fibrils differing from that around the vessels and ducts found through the growth away from their apparent origin, that the increase in amount seemed more probable.

*White Fibrous Tissue and Reticulum.* Mall's preparation showed a network of strands varying in width from the thickness of writing paper to six or seven times this width, with meshes varying in size from a pinpoint to a pinhead. These meshes were quite clear and appeared as open spaces throughout the section.

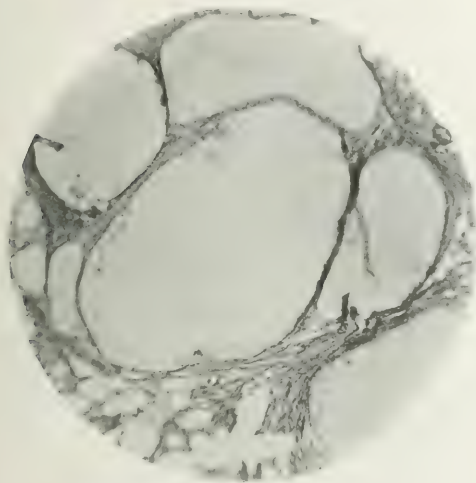


FIG. 3.—Section of a carcinoma of the breast No. 6, digested by Spalteholz' method, showing a group of cell spaces outlined by bundles of wavy fibrils and the entire absence of tissue of any kind in these spaces.

In places the connective tissue forming the network was collected into masses of considerable size up to an eighth or a sixteenth of an inch in size. In other places the larger strands surrounded an open space which was subdivided into two or more smaller meshes by threads of the smallest width. The meshes were for the most part more or less circular in outline.

Sections were examined with low power magnification. The meshes were nearly all quite clear; some, however, had projecting into them from the strands which surrounded them the free ends of the fibrils of which these were composed.

The strands forming the network were composed of minute fibres running in a more or less parallel direction intermingling with one another and for the most part quite wavy.

The elastic tissue apparently decreases in amount as the mamma atrophies after the menopause.

much so that in places, instead of running a continuous course, certain fibrils appeared as a succession of minute spirillae. The majority of the fibres could be traced through out their course.

In many places there was a cross fibrillation, with longitudinal fibrils underlying it, both free ends of the former being seen, evidently the fibrils of the third dimension of the cell space.

In the thinner portions of the section a bundle of fibrils could often be traced down one side of a mesh and curving around a second side, then at the third side dividing some of the fibrils, continuing around the same mesh, while others passed in another direction in the strand between two adjoining meshes and so on, intimately interlacing with one another.

With the high power the finer fibrillary nature of the stroma was much clearer but there was no branching or anastomosis of the fibrils, each being traceable along its course without interruption.

Spalteholz' preparation showed a number of absolutely clear spaces outlined by wavy fibrils in bundles which in some places completely surrounded them, while in others they were continued onward between two adjoining spaces after passing around one or two sides of a mesh. These clear spaces in the control specimen were filled with the cells of the growth and evidently these had no intercellular substance between them. The rest of the section was occupied by bundles of wavy white fibrous tissue fibrils which frequently separated, leaving clear spaces which were in the control specimen filled with small groups of cells.

Mallory's and Van Gieson's stains threw no additional light upon the distribution of the connective tissue in this growth.

Specimen No. 7 was from a small round and spindle-celled sarcoma removed from the thigh of a woman 59 years of age. The tumor commenced in the adductor muscles of the thigh and extended downward in the muscles to the popliteal space. It did not involve the muscles about the knee joint, but passed between the bones of the leg and involved the muscles on the anterior aspect of this. There were also large glands on the front of the thigh of similar structure. In the thigh it completely surrounded the femoral vessels and extended outward between the muscles four or five centimetres. In the popliteal space it surrounded the popliteal vessels. Portions were obtained from the growth in the thigh through the femoral vessels and from the outside of the growth.

*Elastic Tissue.*—The fresh specimens, both the teased and the frozen section, stained with magenta showed considerable numbers of elastic fibres varying in size and character from the fine branching fibres similar to those in areolar tissue to the coarser curly fibres resembling those in the ligamentum nuchae. These fibres ran among the cells of the growth and were found both in the section taken through the femoral vessels and in that from the outside of the growth.

In the Zenker preparation, stained by Weigert's method the blue-stained elastic fibres were plainly visible to the naked eye. Under the low power the sections were seen to be

divided into lobules of different size by strands of white fibrous tissue, the lobules being closely packed with the cells of the growth with very little evidence of intercellular tissue. The elastic fibres occurred in the midst of the strands of white fibrous tissue and were most abundant in the largest strands but also in places running among the cells.

In the strands they existed as very fine straight branching fibres with free curling ends and also as short curly fibres, due possibly to both ends being free. They occurred also here and there in the section as mentioned above as curly fibrils running among the cells.

In the section near the femoral vessels the elastic tissue was much more abundant. With the high power the branching of the elastic fibrils was more apparent. Some of the white fibrous tissue strands were quite free from the blue fibres, and as one proceeded from the femoral vessels outward the amount of elastic tissue grew less, although it was still

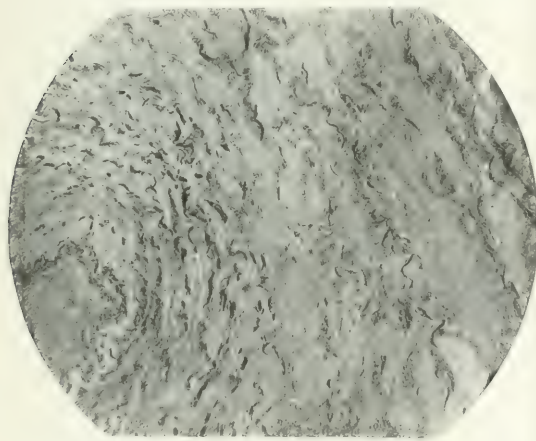


FIG. 4.—Section of sarcoma No. 7, stained by Weigert's method for elastic fibres, showing in dark curling lines the distribution of the elastic fibres. At one side of the section the femoral vessel is seen outlined by elastic tissue and surrounding this are seen layers of elastic fibres lying among the cells of the growth alternating with layers of white fibrous tissue.

present in considerable quantity in the sections from the outside of the growth.

A very peculiar arrangement was present around the femoral vessels. The small round cells had encroached upon the walls of the vessel to the endothelial lining, and from this outward were ranged in definite order layers of small round cells with elastic fibres among them, succeeded by layers of white fibrous tissue with very few elastic fibres one above the other for many layers. The fibres near the vessels were, as a rule, much thicker than those found in the outskirts of the growth.

Unna's orcein stain gave a very similar picture to that obtained with the elastic tissue stained a silky brown.

From the very large amount of elastic tissue found in this growth and from its varying character it would seem fair to conclude that there was considerable new formation of the tissue.

*White Fibrous Tissue and Reticulum. Mall's Preparation.*—For purposes of description the fibres forming this section after digestion may be divided into two groups:

1. Long wavy, more or less parallel fibres running in bundles through the sections, the fibres interlacing with one another. These were evidently white fibrous tissue, and in the control specimen this tissue divided the section into lobules, and in the Weigert preparation it carried the elastic fibres.

2. Exceedingly fine fibrils which formed the ground work and main portion of the section and lay between the bundles of the first group. They formed a very minute meshwork running in every direction, definitely branching and anastomosing and presenting very much the appearance of reticulum

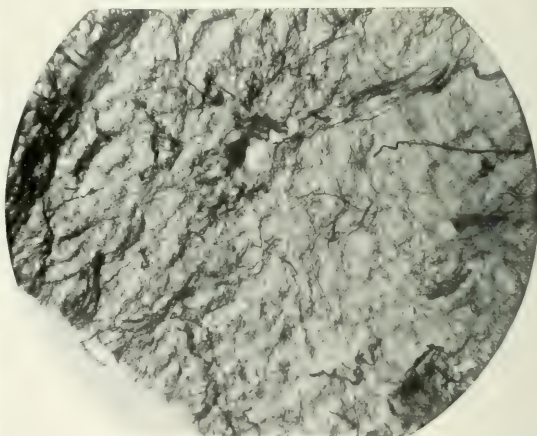


FIG. 5.—Section of sarcoma No. 7, digested by Mall's method, showing the strands of wavy parallel fibrils and the groundwork of minute reticular fibrils occupying the remaining portion of the section. The appearance of a focal origin of these fibrils is quite evident in certain spots.

of normal glands. In some places the fibrils appeared to arise from focal points spreading out in all directions and uniting with fibrils from other points.

Under the high power the fibres of the first groups appeared as above but in the reticular network the branching and anastomosing of the fibrils was much more evident. This network seemed to have no direct connection with the first group but extended a short distance among its fibres as if to gain anchorage there, for in the centre of these bundles they were not nearly so evident.

Throughout the section the apparent focal origin of these fibrils may be due to four or five of these overlying each other at a certain spot.

*Spalteholz' Preparation.* These sections were much thinner



than those by Mall's method, but showed the same points of interest: the strands of white fibrous tissue dividing the section into lobules, and between these strands, and forming the balance of the section, an exceedingly minute network of delicate fibrils which branch and anastomose, the meshes of which were in the control specimen occupied by the round and spindle cells of the growth, by single cells in most cases, but in some cases apparently by groups of two or three or possibly more. However, in those spaces which were occupied by groups of cells there was often seen in this specimen a small jutting branch as if it had been divided in cutting the section. The apparent focal origin of these fibrils was also noticed in these sections.

Specimen No. 9 was from a carcinoma of the uterus.



FIG. 6.—Section of sarcoma No. 7 digested by Spalteholz' method, showing the reticular network with the branching and anastomosis of the fibrils.

It showed no elastic fibres in the fresh preparations but in the hardened section stained by Weigert's stain there were seen in the connective-tissue stroma minute curly fibrils extending for some distance from the vessel's wall, from which they had probably arisen.

*White Fibrous Tissue.*—The sections studied by Mall's method were too thick for accurate observation but the clear spaces of the carcinomatous growth were clearly seen outlined by bundles of wavy parallel fibres of white fibrous tissue.

In Spalteholz' preparation the cell nests and groups of cell nests lay embedded in the connective tissue of the muscle wall but were separated from the same by bundles of parallel fibres. These bundles formed a delicate framework, enclosing large meshes which were quite clear in the section and filled with cells in the control specimen. Fre-

quently the bundles after passing around one side of a mesh would divide into two smaller bundles which would then take part in the formation of the walls of adjoining meshes. Or again, complete rings of four or five wavy fibres were found in apposition at certain points, leaving between them a clear space, which space was also filled with cells in the control section.

The Van Gieson and Mallory preparations showed the closely packed cell nests lying in the muscle wall of the uterus surrounded by connective tissue, but without the slightest evidence of intercellular tissue.

Specimen No. 10 was from a small round-celled alveolar sarcoma arising from the periosteum of the tibia and invading the tibialis anticus muscle in a girl thirteen years of age. It involved the popliteal glands and also a chain of glands extending along the sciatic nerve.

The growth was exceedingly soft and on cutting it a creamy fluid was expressed.

No elastic tissue was found except around the blood-vessels.

In the preparation by Mall's method the connective tissue was very abundant and disposed in a rather coarse network with comparatively thick strands enclosing varying sized meshes, which to the naked eye appeared quite clear.

Under the low power the section was seen to be composed of a network of thick strands leaving meshes of varying size and shape. The strands were composed of bundles of minute fibres which ran a comparatively straight course. The fibres could often be traced curving around certain meshes, interlacing with fibres going in an opposite direction and continuing on their course around and between neighboring meshes. The meshes were for the most part quite clear. In some, however, there was seen a minute reticular network, the fibrils of which branched and anastomosed.

The meshes in the control specimens were partially filled with small round cells. In many places the meshes were divided by single fibres into smaller meshes, and in some portions of the section where the fibrous tissue was most abundant there was found a definite reticular network outlined by bundles of wavy fibrils. This network was composed of anastomosing and branching fibrils similar to that described in case No. 7. The small meshes of this network were filled with the cells of the growth.

The larger meshes were so loosely filled with cells in the stained specimens that it would seem probable that they had contained also the creamy fluid which was expressed on cutting the fresh tissue.

In Spalteholz' preparation there was no connected network on account of the thinness of the section. It was composed of minute wavy fibrils running in various directions and outlining irregular spaces which in the control specimen were loosely filled with cells. The white fibrous tissue framework was here of a very loose texture and the interstices left by this separation of its fibres were filled with small round cells in the control section.

In the midst of the clear spaces were frequently seen cir-

cular wavy fibrils completely enclosing small spaces which were also filled with cells in the undigested specimen.

Numerous vessels in the undigested section were represented in the digested section by small rings of connective tissue lying in the framework.

The stained specimens showed numbers of groups of muscle fibres lying among the cells of the growth.

Specimen No. 11 was taken from a carcinoma of the uterus and contained only a very small amount of carcinomatous tissue.

No elastin was present except around the blood-vessels. The other preparations resembled carcinoma No. 9 in every way.

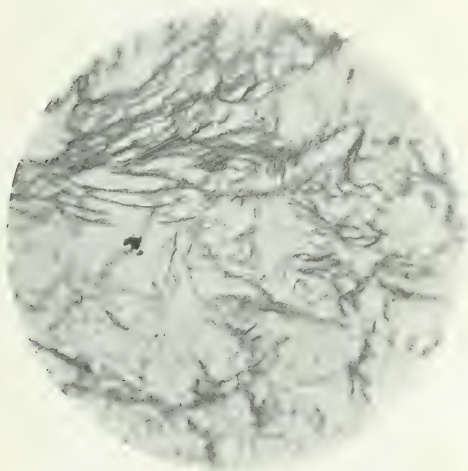


FIG. 7. Section of scirrhus carcinoma of the breast No. 12, by Mall's method, showing the distribution of white fibrous tissue around the small irregular clear cell spaces.

Specimen No. 12 was a scirrhus carcinoma of the breast from a woman 49 years of age. The growth was of six months' duration and involved also the axillary glands on the same side. The nipple was retracted and the skin adherent to the growth.

This growth showed both in fresh and hardened preparations considerable numbers of elastic fibres around the vessels and lactiferous ducts; also around certain groups of cells, and scattered as short wavy fibrils through the abundant connective-tissue stroma.

In the fresh digested specimen the white fibrous tissue was very abundant in bundles of fine wavy parallel fibres running in every direction and enclosing spaces of varying size. The bundles were in many places very thick and the fibres composing them very close together; these, however, gradually spread out leaving in their midst larger spaces. On again, branches from these larger bundles would gradually

thin out and divide to enclose clear spaces and frequently these spaces were separated from one another by a single fibril. There was no anastomosis of fibrils and no reticular network. The clear spaces were filled in the control specimen by small groups of cells, the largest containing probably fifteen or twenty cells, the smallest only two or three.

Spalteholtz' preparation gave in a thinner section much the same picture. Here the wavy fibres were present in bundles which gradually spread out and divided to enclose clear spaces of varying size which were occupied by the cells of the growth in the control section.

This specimen differed from Nos. 6 and 18 (*a*) in the very much larger amount of connective tissue; (*b*) in the smaller and irregular grouping of the cells, and (*c*) in the smaller amount of elastic tissue.

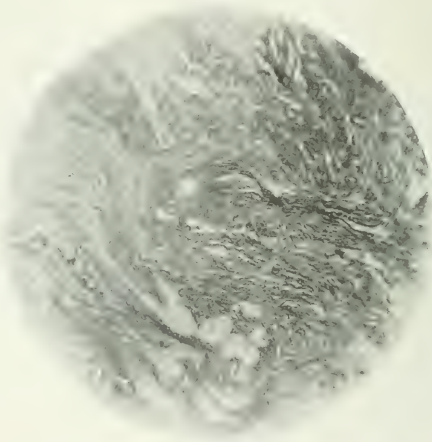


FIG. 8.—Section of fibro-sarcoma of the liver No. 13, by Spalteholtz' method, showing the large amount of fibrous tissue surrounding the clear cell spaces.

Specimens Nos. 13 and 14 were from carcinomata of the liver and rectum in the same individual. The growth was primary in the rectum, where it formed a mass 7 x 6 cm. in size and filled the whole pelvis. There were numerous secondary nodules in the liver from 2 mm. to 5 cm. in diameter. They were firm, opaque and yellowish and surrounded by a zone of greenish-yellow liver substance. The rectal growth had eroded the sacrum and was adherent to it.

These two specimens were of so similar a nature that only one description will be given for both, noting any differences that existed.

The specimens when obtained had already been kept about four days in the ice chest, so that the fresh preparations for elastic tissue were not satisfactory. In the rectal growth, however, by Weigert's stain a few scattered elastic fibres were found running in the midst of the general white fibrous stroma.

**White Fibrous Tissue.**—Both growths contained a great deal of connective tissue, the liver growth more than the renal growth. The type was the same in both, bundles or wavy, more or less parallel fibres running in every direction and outlining clear spaces of varying size which were filled with epithelial cells in the control section. These sections resembled very much the scirrhus growths from the breast, but the fibrous tissue was here even more abundant.

In Spalteholz' preparation the section was thin, the thickness of two or three fibres. The fibres ran in many directions, their further course in any one direction ceasing when they encountered bundles running in an opposite direction. In the midst of the bundles minute openings were seen where the constituent fibrils separated slightly from one another, and in these spaces the connective tissue corpuscles were seen to lie in the control specimen. Here also the curving of the fibres around two or more sides of a clear space and onward between two adjacent spaces was clearly seen.

Specimen No. 16 was from a scirrhus carcinoma of the breast of eight years' growth in a woman forty-four years of age.

This growth resembled very much that described in No. 12. It contained, however, many more elastic fibres running through the white fibrous stroma, but these were confined to the stroma and to the ducts and blood-vessels, and did not in any case surround groups of cells, nor were they nearly so abundant as in case No. 6.

Specimen No. 17 was from a small round and spindle-cell sarcoma taken from the axillary region. It had a thin translucent capsule and could so be separated from the surrounding tissues, the connection consisting only of fine branching connective-tissue fibres and numerous small blood-vessels. Its origin was evidently from the intermuscular connective tissue and the growth itself was soft, elastic and lobulated, measuring  $13\frac{1}{2} \times 10 \times 18$  cm. Its duration was 20 months, and it involved also a number of glands in the supra-clavicular fossa.

No elastic fibres were found in either the fresh or hardened preparations.

The digested specimens, both by Mall's and Spalteholz' method, showed the same reticular network as that described in section No. 7, and also the same white fibrous bundles enclosing this network. Neither the Van Gieson nor Mallory preparations showed the large amount present nor its distribution.

Specimen No. 18 was from a carcinoma of the breast of four months' growth in a woman thirty-seven years of age. At removal it was present as a hard regular mass freely movable and measuring  $4 \times 2$  cm. in size.

This was an exceedingly cellular growth, thus differing from cases No. 12 and 16, but it resembled very much case No. 6 both in the distribution of elastic and white fibrous tissue and in the type of cell of which it was composed.

that in the latter instance No. 18 was of a much more malignant type filled with young cells and almost resembling a small round-celled sarcoma.

**Elastic Tissue.**—The elastic tissue here was disposed in a very similar way to No. 6, but was not so abundant.

In this growth a comparison was made with a portion of normal breast from the same case with reference to the amount and distribution of the elastic tissue with the following result: that the elastic tissue in the growth was found to be not so abundant as in the normal breast, but differed somewhat in distribution. In the normal structure the elastic tissue was confined to the coats of the vessels and lactiferous ducts occasionally occurring in bundles in the stroma of the gland, while in the growth, besides being around the vessels, it was present surrounding large groups of cells, evidently invaded ducts, and as minute wavy fibrils was most abundant in the stroma, but frequently was found in among the cells with apparently no white fibrous tissue accompanying it; also as bundles of fibres which were infiltrated with epithelial cells.

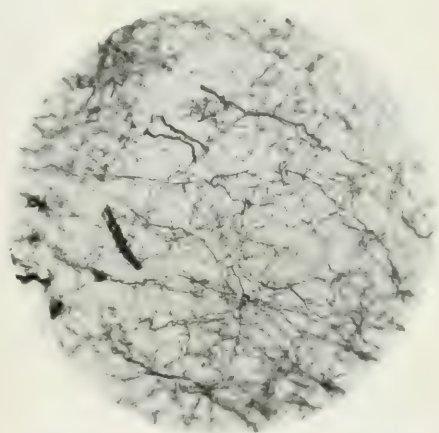


FIG. 9.—Reticular network from sarcoma of axilla No. 18, prepared by Mall's method.

In spite of the very cellular condition of the growth it presented on digestion the distribution of fibrous tissue described under case No. 6 of large cell spaces with no intercellular network.

#### CONCLUSIONS.

1. Elastic fibres are frequently present in new growths: (a) in the stroma; (b) among the cells; (c) around the blood-vessels, and (d) in breast tumors around the lactiferous ducts which have been included and invaded by the growth.

2. When present they are usually in connection with pre-existing elastic-tissue elements in the original tissue in which the tumor has grown.



3. New formation probably occurs but can only be determined by a comparison of that present in the growth with that present in the normal tissue in which the growth has arisen.

4. Sarcomata present a large increase in connective tissue and possess an exceedingly fine intercellular reticular network very similar in structure to the reticulum present in normal glandular tissue.

5. Carcinomata possess a stroma of white fibrous tissue, outlining the cell spaces, but have no intercellular network.

6. The digestion methods present a possible means of diagnosis between carcinomata and sarcomata in doubtful cases.

7. Uterine myomata have a very large amount of connective tissue both of a white fibrous and reticular nature, possessing a connective-tissue capsule for each muscle cell; and it would be more correctly termed fibromyomata.

## ON THE RELATION OF THE ELECTRICAL CONDUCTIVITY OF BLOOD-SERUM TO ITS ALLEGED BACTERICIDAL POWER.

BY EMMA LOOFZ AND ALICE WELD TALLANT.

(From the Pathological Laboratory of the Johns Hopkins University and Hospital.)

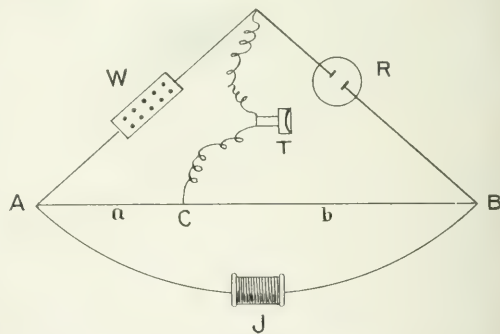
As is well known, it is asserted that blood-serum possesses certain bactericidal properties, and many experiments tend to show that these properties are lost when the serum is heated to from 55-60° C. In a recent article Baumgarten<sup>1</sup> advances the theory that the bactericidal power of the serum is due, not to the actual existence of bactericidal substances in it, but to the fact that bacteria, in being transferred from their natural surroundings to another medium, undergo sudden changes in assimilation and plasmolysis.

Following the line of thought of this article, Dr. L. F. Barker suggested that the writers undertake experiments to discover whether any physico-chemical change could be demonstrated in serum heated to the specified temperature. Electro-chemical examination of the conductivity of the serum was the method chosen, and the following experiments were carried out:

The serum was carefully obtained from dog's blood in the pathological laboratory; the work on conductivity was done in the Chemical Laboratory of the Johns Hopkins University through the courtesy of Dr. Harry C. Jones. The apparatus used is described by Dr. Jones<sup>2</sup> as follows:

"J is a small induction coil, with only one or two layers of wire. A larger coil must not be used, since it does not give a sharp tone minimum in the telephone. The coil tuned to a very high pitch, should be enclosed in a box surrounded by a poor conductor of sound, and placed at some distance from the bridge where the reading is to be made. The coil is driven by a storage cell of medium size. A platinum wire, or better, one of manganese alloy, which has a small temperature coefficient of resistance, is tightly stretched over the meter stick AB, which is carefully divided into millimeters. A rheostat W, whose total resistance amounts to 11,110 ohms, is convenient. The resistance vessel R, containing the solution and electrodes—the electrodes are cut from

thick sheet platinum, and into each plate a stout platinum wire, about an inch in length, is welded. Glass tubes are sealed on to the platinum wires and electrode plates, by means of sealing glass. . . . These tubes pass tightly through a rubber cap, which fits over the glass vessel. They are filled to a convenient height with mercury, and electrical connection, established by means of copper wires, which dip into the mercury. One arm of the telephone, T, is thrown into the circuit between the rheostat and the resistance, and the other arm is connected with the bridge wire, by means of a slider. This is moved along the wire until that point is found at



which the hum of the induction coil ceases to be heard in the telephone. Let this be some point C, and let us represent AC by a, and BC by b, the resistance of the solution in the vessel R by r, and the resistance in ohms in the rheostat by w; then from the principle of the bridge, we have

$$ra = wb$$

$$r = \frac{wb}{a}$$

But the conductivity of a solution, c, is the reciprocal of the resistance, r; therefore,

<sup>1</sup> P. Baumgarten. Beiträge zur Lehre von der natürlichen Immunität. Berl. klin. Wchnschr., No. 41, Oct. 9, 1899.

<sup>2</sup> Harry C. Jones. The Freezing-Point, Boiling-Point and Conductivity Methods.

$$c = \frac{a}{wb}$$

... A cell-constant,  $C$ , must be introduced and determined for each cell before it can be employed for conductivity measurements."

In calculating the molecular conductivity of a substance, its molecular concentration must be taken into account, but in these experiments this was not considered necessary. The results given in the tables express the conductivity simply as the reciprocal of the resistance,  $r$ , according to the formula

$$c = C \frac{va}{wb}$$

The material used in the experiments was dog-serum, obtained under proper aseptic precautions. In the first experiment the serum was heated from 24 to 70° C., and its conductivity tested at the following temperatures: 24°, 30°, 38°, 50°, 51°, 52°, 53°, 54°, 55°, 56°, 57°, 58°, 59°, 60°, 70°. The material was kept at each of these temperatures long enough to ensure a constant reading, and the temperature was not raised above 70°, on account of the changes in concentration which would have occurred from evaporation.

Five more experiments were performed with serum taken from different dogs. The conductivity was tested at 24°, the material was then heated to 57° and kept at this temperature for one hour, after which it was slowly cooled to 24°, and

the conductivity again tested, to discover if any change had taken place. The results of these experiments are incorporated in the following tables. The figures in each case represent the mean of three readings.

## EXPERIMENT I.

24° .....	11.333	55° .....	19.283
30° .....	12.753	56° .....	19.643
38° .....	14.096	57° .....	19.881
50° .....	17.873	58° .....	20.133
51° .....	18.16	59° .....	20.41
52° .....	18.526	60° .....	20.73
53° .....	18.8	70° .....	23.253
54° .....	19.053	After cooling—	
		38° .....	14.743

The gradual increase in conductivity is, of course, due to the rise in temperature.

	Before heating to 57° C. for 1 hour.	After heating to 57° C. for 1 hr. and again cooling to 24° C.
Experiment II. 24° .....	11.436	11.466
Experiment III. 24° .....	11.786	11.763
Experiment IV. 24° .....	11.48	11.486
Experiment V. 24° .....	11.446	11.446
Experiment VI. 24° .....	10.546	10.56

The results of the above experiments go to prove that the alleged loss of bactericidal power in blood-serum heated to 57° is not due to any chemico-physical change which can be demonstrated by the conductivity method.

## A CONTRIBUTION TO THE STUDY OF MALIGNANT TUMORS ARISING IN CONGENITAL MOLES.

By R. H. WHITEHEAD, M. D., *Chapel Hill, N. C.*

(From the Pathological Laboratory of the Johns Hopkins University and Hospital.)

In 1893 Unna<sup>1</sup> announced his belief that melanotic malignant tumors which originate in pigmented moles should be classed as carcinomata. He based his opinion upon an examination of some tumors of this sort, and especially upon a study of moles obtained from newborn and very young children. According to him, the groups of pigmented cells commonly found in moles are derived from the epidermis during embryonic life or early childhood by being cut off from the interpapillary processes of the rete Malpighii, and afterwards losing their prickles and undergoing other metaplastic changes. He concluded, therefore, that melanotic tumors arising in moles are not sarcomata, but carcinomata.

Since, at that time, it was generally held that the so-called nævus cells were of endothelial origin, Unna's statement aroused considerable opposition. Green<sup>2</sup> denied the epider-

mal genesis of the nævus cells, and pointed out that there is no relation between the amount of pigment in them and that in the epidermis—that it may be present in either situation while absent from the other.

Then Bauer,<sup>3</sup> a pupil of Ribbert, investigated the subject, and reached conclusions quite the opposite of those of Unna, even after examining Unna preparations. He convinced himself that the nævus cells were of endothelial origin, and stated, furthermore, that the individual cells in the groups were separated from one another by a fine fibrous network, and that they were frequently branched so as to resemble stellate connective-tissue cells.

Lubarsch<sup>4</sup> stated that he had examined a considerable number of moles in newborn and young children, and had

<sup>1</sup> Unna, P. G. Nævi und Nævocarcinome. Berl. klin. Wchnschr., 1893, XXX, 14.

<sup>2</sup> Green, L. Ueber Nævi pigmentosi. Virchow's Archiv, 1893, CXXXIV, 331.

<sup>3</sup> Bauer, C. Ueber endotheliale Hautwarzen und ihre Beziehungen zum Sarcom. Virchow's Archiv, 1895, CXLII, 407.

<sup>4</sup> Lubarsch-Ostertag. Ergeb. d. allg. Pathol., etc., Wiesbaden, 1896, Bd. II, S. 379.

not been able to detect any correspondence between the nævus cells and those of the epidermis.

Unna, however, did not fail to find supporters. Delbanco,<sup>5</sup> as the result of his study of two moles, stated that the inter-papillary processes of the epidermis are frequently in direct connection with the groups of nævus cells, and that, owing to proliferation of the stroma of the mole, numerous epidermal cells are separated off into groups and afterwards displaced into the lymph vessels.

Kromayer<sup>6</sup> rejected Delbanco's conclusion that the nævus cells are contained in lymph vessels, but agreed with him and with Unna in deriving them from the epidermis. This investigator describes in the moles of infants cyst-like spaces filled with cells containing vesicular nuclei. They are situated in the epidermis, between the epidermis and the subjacent connective tissue, or entirely within the latter. He thinks that all of these groups of cells become enclosed by connective tissue later on, and that then the cells throw off fibres, until finally little is left of the individual cells save nuclei closely applied to fibres—that, in fine, the epithelial are metamorphosed into connective-tissue cells.

Lubarsch,<sup>7</sup> in a critical review of the work done up to that time, expressed the opinion that the researches of Unna, Delbanco, and Kromayer were individual interpretations of microscopic pictures rather than objective descriptions of appearances actually observed, and that their illustrations were susceptible of more than one interpretation. Thus, he claimed that Kromayer's picture representing nests of nævus cells in the epidermis could be reproduced by oblique sections of the skin in conditions characterized by elevations of the epidermis, as the result of growing or proliferating papillæ. Nor was he willing to accept Kromayer's metaplasia of epithelial into connective-tissue cells, holding that the law of the legitimate succession of differentiated cells was too well established to be surrendered on such proof as Kromayer presented. He criticized also the method with which Kromayer worked, and was not convinced by his original preparations. Still, he was unwilling to deny the possible existence of epithelial nævi.

A little later Scheuber<sup>8</sup> made serial sections of several pigmented moles, and convinced himself that Unna's view as to the origin of nævus cells was correct.

Recently Gilchrist<sup>9</sup> has made an investigation of the subject, and, from the study of a pigmented mole in an infant, arrived at the conclusion that the nævus cells are developed in the way described by Unna.

<sup>5</sup> Delbanco, E. Epithelialer Nævus. *Monatsh. f. prakt. Dermat.*, 1896, XXII, 105.

<sup>6</sup> Kromayer, E. Zur Histogenese der weichen Hautnævi. *Dermat. Ztschr.*, 1896, III, 263.

<sup>7</sup> *Op. cit.*, S. 591.

<sup>8</sup> Scheuber, A. Ueber den Ursprung der weichen Nævi. *Arch. f. Dermat. u. Syph.*, 1898, XLIV, 175.

<sup>9</sup> Gilchrist, T. C. On Malignant Growths Arising from Pigmented Moles. *Journ. Cut. and Genito-Urin. Dis.*, 1899, XVII, 117.

Finally, Schalek<sup>10</sup> has studied some pigmented moles and melanotic tumors of the skin, and has satisfied himself of the correctness of Unna's views.

In the midst of such difference of opinion one finds it difficult to reach a definite conclusion as to the nature of the nævus cells; but the pictures of Scheuber and of Gilchrist are, to say the least, exceedingly suggestive, and one may fairly be permitted to hold the view that in some moles, at least, the groups of cells are modified epithelial cells of epidermal origin. Should a tumor spring from such cells, we should, naturally, expect it to follow the type of carcinoma. This expectation, however, is not always realized. Unna,<sup>11</sup> indeed, states that all of these tumors which he has studied presented the structure of alveolar carcinoma (carcinoma simplex). On the other hand, the nine tumors of this class which I have been able to examine, had that histological structure which most pathologists have agreed to call alveolar sarcoma,<sup>12</sup> and were so pronounced by competent observers. While we may well hesitate to be dogmatic in such matters, yet one is reluctant to regard as a carcinoma a tumor which presents so many characteristics of the sarcomata.

The following cases are reported not so much with the hope of throwing new light upon this vexed question as rather to call attention to the fact that tumors may spring from congenital moles which represent the same processes as those going on in the melanotic tumors, with the exception that they totally lack true melanotic pigment.

CASE 1.—The subject of this tumor was a white man aged 47 years. He had noticed, as long as he could remember, a "black mole" on the front of his right forearm a little above the wrist. For the last few weeks this had been enlarging rapidly, so that when I saw him there was in the situation mentioned a perfectly black tumor, conical in shape, and about 2 cm. high. The color was due largely to clotted blood, with which the tumor was encrusted, owing to frequent hemorrhages. The growth was removed by incisions carried widely into apparently healthy tissues. Eight months afterwards I learned that he had died "with tumors all over him." They were estimated as at least 200 in number, were situated in and beneath the skin, and varied in size from that of a pea to that of a hen's egg. Towards the end of his life he suffered much from frequent painful micturition, and on several occasions passed in his urine fleshy masses believed by his medical attendant to be pieces of tumor.

On section the tumor was deeply pigmented in places, and was spongy and friable, tending to crumble to bits when handled at all roughly. It arose by a broad, short pedicle a little more than one cm. thick.

In longitudinal sections through the pedicle the latter is seen to be formed by dense fibrous tissue containing sweat

<sup>10</sup> Schalek, A. Contribution to the Histogenesis of Melanocarcinoma of the Skin. *Journ. Cut. and Genito-Urin. Dis.*, 1900, XVIII, 145.

<sup>11</sup> Unna, P. G., *op. cit.*



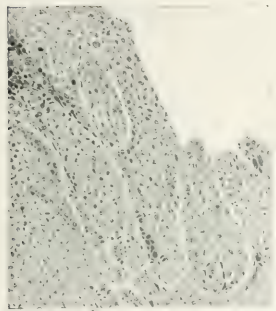


FIG. 1. Shows structure of the tumor in Case I.

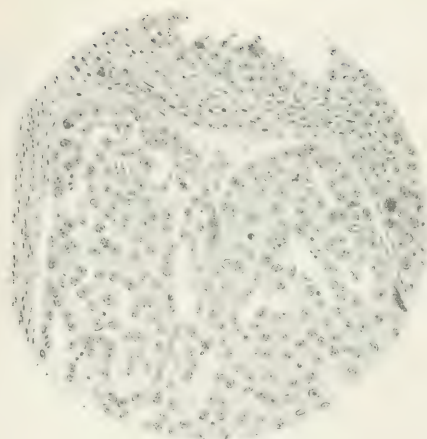


FIG. 2. CASE I.—Shows the intraalveolar reticulum.



FIG. 3. CASE II.—Portion of a cell-mass of the first variety.

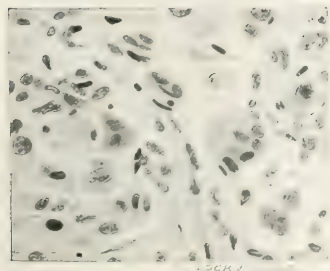


FIG. 4. CASE II.—Portion of a cell mass of the second variety.

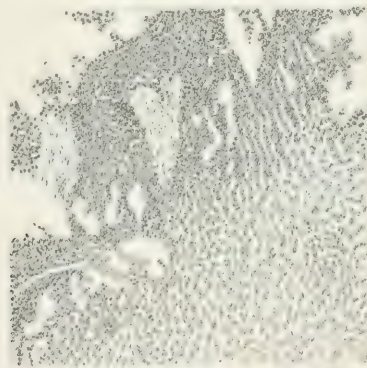


FIG. 5. CASE II.—Transition from a mass of the first variety to one of the second variety.



and sebaceous glands and a few hair roots. Proceeding towards the tumor proper, many young capillaries are encountered containing numerous polymorphonuclear leucocytes and surrounded, here and there, by groups of small round cells. In this region pigment begins to appear as small masses of a yellow-brown color. In some cases these masses are contained in branched cells; in others I am unable to decide whether they are intra- or extracellular in situation. Near the pedicle the arrangement of the tumor is alveolar in character, though the stroma soon becomes very scanty, the walls of the alveoli being quite delicate and furnished by a few spindle-shaped cells. The cells within the alveoli are, in the main, large and polygonal; their nuclei are fairly constant in size and appearance, being vesicular with nucleoli and grains of chromatin. Cells with several or budding nuclei are frequently seen. In certain alveoli from which some of the cells have been removed by shaking, it can be seen that the cells are separated from one another by a very fine reticulum, which appears to consist in large part of processes from the cells themselves. Many of the cells contain pigment in the form of yellow-brown grains. Farther towards the periphery of the tumor the alveolar is succeeded by what may be termed a diffuse arrangement of the cells. Here the stroma, reduced to a minimum, is represented only by a few parallel rows of endothelial cells running here and there through the large masses of cells. It is difficult in this region to detect any intercellular substance; occasionally one sees cells with fibrillar processes. Very common are exceedingly large cells, spherical and multinucleated, containing many granules of pigment. The superficial portions of the tumor are inflamed or necrotic, and infiltrated with blood. The areas still living consist of large vascular spaces lined by endothelium and surrounded by masses of tumor cells. The epidermis near the pedicle is thickened, but no connection can be made out between it and the tumor proper. In other situations the epidermis has broken down before the invading masses of tumor cells, which grow through and project beyond it. It has entirely disappeared from over the greater portion of the surface of the tumor. In the thickened epidermis a few epithelial pearls were noticed, some of which contained pigment. The tests for iron-containing pigment resulted negatively.

Here we have a typical example, in an advanced stage, of the malignant melanotic growths which spring from the *nævus* cells of congenital moles—the *nævus* carcinomata of Unna, or the alveolar melanotic sarcomata of most authors.

CASE 2.—This tumor was obtained, through the kindness of Dr. C. S. Mangum, from a white woman 50 years old. She consulted Dr. Mangum concerning a large mole situated over the inferior angle of the left scapula. It had been present "all her life," but only recently had been enlarging. Dr. Mangum thought best to remove the mole, especially as there were evidences of beginning ulceration. The subsequent history, unfortunately, could not be fully obtained. It was learned, however, that the wound made by the operation never healed, and that the lymph nodes in the left axilla

soon became enlarged. About eighteen months after the operation she was considered by her family physician to be dying of a malignant tumor of the uterus.

The tumor is about 2 cm. long, and 1 cm. thick. It presents the macroscopical appearances of soft papilloma, its surface being corrugated. It possesses a short, narrow pedicle. On section it is seen to be pigmented in streaks of a dark slate color.

In sections made through the center of the mole including the pedicle, the latter is found composed of fibrous tissue; its arteries are thickened, and there are some patches of small round cells. In these sections the structure is quite suggestive of carcinoma simplex. There are variously shaped alveoli, for the most part long and narrow, whose walls are thick and formed by dense fibrous tissue with scanty spindle cells. The cells within the alveoli are packed closely without visible intercellular substance. They are regular in size and appearance, being rather small polyhedral cells with pale vesicular nuclei. This area, doubtless, consists of normal mole tissue.

Sections made through the other portions of the tumor, however, present a different picture. The most prominent feature is furnished by large, more or less round collections of cells surrounded by capsules of dense fibrous tissue. They are not all alike, but may be divided into two varieties. The more numerous ones are composed, in the main, of small polygonal cells with deeply staining nuclei, though occasionally one sees a very large cell with more than one nucleus. The primary mass of cells is subdivided into much smaller masses by a spindle-celled connective tissue, which runs in from the surrounding connective tissue, and conveys vessels. In most cases this tissue is quite scanty, and often the subdivisions seem to be separated only by narrow cracks, the boundaries of which are the tumor cells, though sometimes a few spindle cells can be seen bordering them. No intercellular substance can be made out between the cells in the subdivisions. In some of the masses the thickness of the connective tissue septa is much greater than in those just described, and then an appearance is produced somewhat like that described in sections through the center of the tumor.

The cell masses of the second variety are not so numerous as those of the first, and are not so sharply circumscribed. The cells composing them are, for the most part, very large and round, and many of them contain more than one nucleus. They are separated from one another by a delicate reticulum, which frequently holds deeply staining nuclei; or several cells may be shut off into small groups by portions of the reticulum. As a rule, the cells towards the periphery of these masses tend to assume the spindle shape, and gradually fade away into the surrounding connective tissue. Areas are observed where a mass of the first variety is passing by gradual transition into one of the second variety. Moreover, in the case of both varieties, columns of cells advance into the surrounding stroma, where they usually tend to the spindle shape.

The stroma of the tumor is furnished by a central trunk of fibrous tissue, which gives off branches here and there to surround the cell masses alluded to. It conveys many blood-



vessels, around which are some patches of small round cells and many plasma cells, and contains scattered, long, narrow spindle nuclei. In several places this tissue is lost in diffuse masses of large spindle-shaped cells, for which it seems to form an intercellular substance.

The surface of the tumor is covered everywhere by epidermis, which is necrotic over a considerable extent of the tumor. Where the epidermis is intact, it is seen to be very thin—it is reduced to two or three layers of cells, and is separated from the subjacent tissue by distinct lines of connective tissue. Some epithelial pegs project from the epidermis, but they, too, are very thin, and show no connection with the tumor cells. The pigment was found chiefly along the course of the blood-vessels and in the most superficial parts of the growth, where hemorrhages had occurred. Much of it responded positively to the ferrocyanide of potassium

test, and the remainder was amorphous hæmatoidin contained largely in polymorphonuclear leucocytes.

In this case, it would seem, the processes which occur in the malignant melanotic tumors are undoubtedly going on—the development of a malignant tumor from the nests of nævus cells in a congenital mole, but with the exception that true melanotic pigment is not present. *A priori*, we should expect to find such tumors, for Green<sup>12</sup> has shown that the nævus cells are not always pigmented, nor are tumors which arise in melanotic tissues invariably melanotic, but I have not been able to find the records of a similar case. Unna<sup>13</sup> hints at the possible existence of such growths, but makes distinct mention only of melanotic tumors.

<sup>12</sup> Green, L. *op. cit.*

<sup>13</sup> Unna, P. G. *Die Histopathologie der Hautkrankheiten.* Berl., 1894, pp. 746-752.

## INORGANIC FERMENTS.<sup>1</sup>

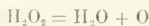
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A paper bearing this title has recently appeared by Bredig and Müller von Berneck.<sup>2</sup> The authors first point out certain analogies between the action of ferments and the contact action of metals. Alcohol is oxidized to acetic acid by the oxygen of the air as well by finely divided platinum as by the organic ferment *mycoderma aceti*. Calcium formate is decomposed into calcium carbonate, carbon dioxide and hydrogen, not only by certain bacteria, but by finely divided iridium, rhodium, or ruthenium. Finely divided platinum, palladium, iridium, osmium, etc., have the power of inverting cane sugar, like invertase.

The above relations are, however, only analogies. To determine whether there is any close relation between the action of organic ferments and finely divided metals, some reaction effected by both classes of substances must be carefully studied.

The reaction chosen by the authors of this paper is the decomposition of hydrogen dioxide. This reaction is effected by all organic ferments and, also, by finely divided metals, in the sense of the following equation:



The metal chosen was platinum, and a colloidal solution of this substance was prepared as follows: Two platinum wires about 1 mm. in diameter were immersed in a vessel containing very pure water. These were placed at a convenient distance apart, and a current of from 8 to 12 amperes and 30 to 40 volts passed between them. There was thus formed an arc between the platinum poles beneath the surface of the water. Platinum was torn off from the cathode in a

very finely divided condition, and quickly gave a blackish-brown color to the surrounding water. The liquid was then rapidly filtered through a folded filter to remove any larger particles of platinum which may have been torn off. The colloidal solution of platinum is a clear, dark brown liquid, which, when examined under the microscope, appears to be perfectly homogeneous. The platinum particles must, therefore, be of an order of magnitude less than a wave-length of light. The amount of platinum contained in the solution could be easily determined by treating with a little concentrated hydrochloric acid. The platinum was precipitated and could be filtered off and weighed. The decomposition of hydrogen dioxide by means of this liquid was then studied.

There are two striking characteristics of the action of organic ferments. First, a very small amount of the ferment can effect a large amount of reaction. Second, the ferment itself very probably does not enter, as such, into the reaction.

Bredig and von Berneck studied the action of the colloidal platinum with reference to these two points. They found that a gram-atomic weight of platinum in about 70,000,000 litres of water would appreciably decompose hydrogen dioxide. This showed that an almost infinitesimal amount of the metal was capable of effecting the reaction. Similar results were obtained with other metals and metallic oxides, such as manganese dioxide, cobalt oxide, copper oxide, lead dioxide, etc. The first point of resemblance between the action of organic ferments and of these inorganic substances is thus evidently very close.

The method of testing the second point, whether the metal enters into the reaction, is at first sight not so obvious. Indeed, there is no strictly chemical method for deciding this

<sup>1</sup> Presented to the Johns Hopkins Hospital Medical Society.

<sup>2</sup> *Ztschr. phys. Chem.* (Jubelband zu van't Hoff), 31, 258.

point. The fact that the platinum remains in the solution after the reaction in the same condition as before, is no proof that it has not entered into the reaction and then came out again as such. There is, however, a physical-chemical method by means of which this problem can be easily and satisfactorily solved. If the platinum does not enter into the reaction but acts only by contact, it is evident that there is only one substance reacting. Such reactions are termed monomolecular. If the platinum does enter into the reaction there are two substances reacting, and such a reaction is termed bimolecular. We can distinguish very readily between mono- and bimolecular reactions. Without entering too far into the mathematical side of the problem, it has been shown from the law of Mass Action that for reactions of the first order the expression connecting the time during which the reaction has proceeded with the amount of substance transformed is:

$$\frac{1}{g} \ln \frac{A}{A-X} = C$$

in which  $g$  is the time,  $A$  the original amount of substance,  $X$  the amount decomposed, and  $C$  is a constant.

Similarly, for reactions of the second order we have:

$$\frac{1}{g} \frac{X}{A-X} = C$$

in which the symbols have the same significance as above.

To determine the order of the reaction it is only necessary to decide experimentally between these two equations. This is quite simple. It is only necessary to know the amount of hydrogen dioxide with which we start, ( $A$ ) and to measure the amount transformed ( $X$ ) in any given time ( $g$ ). Then substitute these values in the above equations and obtain  $C$ . Having done this for any given time, allow the time to vary and measure  $X$  for the new time. Again calculate  $C$ . Repeat this process for a number of values of  $g$  and calculate  $C$  in each case from both equations. If the values of  $C$  are a constant for varying values of  $g$  as calculated by the first equation the reaction is one of the first order. If, on the contrary,  $C$  comes out a constant as calculated by the second equation the reaction in question is one of the second order.

In the reaction with which we are dealing,  $C$ , as calculated by the first equation, is a constant, and hence the decomposi-

tion of hydrogen dioxide by platinum is a monomolecular reaction. The platinum, therefore, does not enter into the reaction, and we have established the second point of resemblance between the action of organic ferments and that of finely divided platinum.

The most striking analogy between the action of the colloidal platinum and of organic ferments still remains to be considered. It is well known how sensitive organic ferments are to the action of certain poisons. The same phenomenon is manifested by the solution of platinum. Thus, a gram-molecular weight of hydrocyanic acid in one million litres of water reduces, quite appreciably, the action of the platinum solution on hydrogen dioxide. Hydrogen sulphide has also a poisonous action. A gram-molecular weight of the gas dissolved in 345,000 litres of water diminishes the velocity with which the colloidal platinum will decompose hydrogen dioxide, and a solution of hydrogen sulphide ten times as concentrated as the above, reduces the velocity of the reaction nearly to zero. Carbon bisulphide and mercuric chloride also exert a poisonous influence on the solution of platinum, reducing the rate at which it will decompose hydrogen dioxide, and, if present in sufficient quantity, entirely preventing the reaction.

Whatever conclusions may be drawn from this work the fact cannot be disregarded that there are a number of very striking analogies between the action of finely divided platinum and that of organic ferments. While it seems to the reviewer a little premature to draw final conclusions, yet enough has already been done to show that this is a very promising field for investigation. If it should be shown that these analogies are deep-seated, then, work of this kind cannot fail to throw light on the nature of fermentation and similar processes. Metallic platinum in the form of a colloidal solution is one of the simplest substances known to the chemist. Organic ferments are in general very complex. If the action of the two is analogous, then, by studying the action of the simpler substance much light may be thrown on the *modus operandi* of the more complex enzymes.

It is impossible to say at present to just what this work may lead. It is certainly an important step in a direction which is full of promise, and is another example of the way in which physical chemistry is throwing light, not only on chemical and physical problems, but also on biological.

## THE STERILIZATION OF CATGUT.

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The value of absorbable suture and ligature materials has been for years so apparent that much work has been done to secure one which would answer the conditions imposed by the requirements of aseptic surgery. Catgut is the cheapest

and best of such materials. Its properties are so well known that an enumeration of them here would be superfluous. The principal objection to its use as sutures or ligatures is the difficulty experienced in its sterilization.

In the spring and summer of 1899 I tested several methods which seemed to me the most promising of the many in use. My endeavor was to secure a method of catgut sterilization so simple in its technique that it could be generally adopted. There are two conditions which must be fulfilled and several which it is desirable to meet in the preparation of catgut for surgical purposes. The first essential condition is, that the sterilization must be perfect. Not only must the pyogenic cocci be killed, but the spores of the most resistant bacteria, whether pathogenic or not, must likewise be destroyed by the sterilizing process. It is not sufficient to have a method which apparently gives good clinical results. In the literature of the subject we find many methods which have been extensively used and the results clinically declared good, which careful bacteriological tests prove to be untrustworthy. The reason of the discrepancy is probably the following: The method of sterilization destroys the least resistant bacteria and inhibits to a certain extent the growth and development of the more resistant. When such catgut is placed in tissue which is well supplied with blood the bacteria and their spores in their weakened condition are destroyed by the tissue juices, leucocytes, etc. Place such catgut, however, in conditions which favor the development of these bacteria, as in a large blood-clot or in tissue cut off from its blood supply, and we may easily conceive of a very different result. The bacteria or their spores finding here conditions favoring their development and multiplication may grow as on the common nutrient media in the laboratory and having acquired sufficient powers of resistance may invade the human organism. Bacteria which are considered non-pathogenic may cause the decomposition of such a clot and the absorption of the products so formed may act to the detriment of the patient.

In my experiments I have seen the spores so acted upon that only after several days would they slowly develop into bacteria when placed in *bouillon* at a favorable temperature. Placed immediately upon nutrient agar or gelatin they would not grow, but after their development in *bouillon*, when transplanted to these media, they would grow readily. The conscientious surgeon would not to-day use any suture material which is not certainly sterile.

The second essential condition is that the catgut must be strong and pliable. After fulfilling these essential conditions the ideal method of sterilization should fulfil others, viz., the method should not require too much time nor be too troublesome, the catgut should not be swollen, it should be kept in some manner where it is not easily contaminated, it should be easily transportable, and it should be free from poisonous or irritating chemical substances.

The various methods in use depend upon heat, chemical agents, or a combination of the two as a means of sterilization. Heat is an ideal method of sterilization so far as the destruction of the bacteria is concerned. A sufficiently high temperature will destroy all bacteria known to us and leave no extraneous irritating substances in the material sterilized. The problem is the method of applying the heat so as not to impair too much the strength and pliability of the catgut.

It has been found that catgut, which has been thoroughly dried, will stand a high degree of heat without much injury. Upon this principle depends the "Dry Heat" and the "Cumol" methods of sterilizations. Chemical agents, on the other hand, are uncertain in their bactericidal properties and investigators are becoming daily more sceptical as to these properties. Soak contaminated silk or catgut in a carbolic acid or mercuric chloride solution and place these materials on nutrient media without washing out or neutralizing these chemical agents and enough of the carbolic acid or mercuric chloride may remain in the strands of silk or catgut to prevent the development of the bacteria. Neutralize or wash out thoroughly the chemical agents and the microorganisms will grow. Upon this depends the apparently favorable bacteriological tests of many untrustworthy methods. Reppert first called attention to this. The agent used also remains in the catgut and may do harm where much of the material is used.

In looking over the methods of catgut sterilization in more general use the following ones suggested themselves as the most promising: Schäffer's, Vollmer's (Formalin), Reverdin's (Dry Heat), Krönig's (Cumol), Sweetnam's.

I will give a short description of each and my tests bacteriologically in a tabulated form.

*Schäffer's Method.*—This method, which is one of the simplest in its technique, is as follows: The catgut without previous preparation is boiled in the following solution: absolute alcohol, 85 ccm.; distilled water, 15 ccm.; pure mercuric chloride, .5 grm. At least 250 ccm of this solution is placed in an apparatus devised by Schäffer along with the catgut and by means of a water bath brought slowly to the boiling point of the liquid. After 15 minutes vigorous ebullition the alcoholic solution is allowed to cool 5-10 minutes, the catgut is removed and placed in 95 per cent alcohol, and it is ready for use. Schäffer says in his article in conclusion, that the catgut is absolutely sterile, that it loses none of its strength, that the sterilization takes only 30-40 minutes, and that the apparatus cost only 15 marks. He has written an exhaustive article upon the subject of catgut sterilization and in it reviews many other methods, all of which he regards as faulty. I gave his method a thorough bacteriological test, using the utmost care in carrying out his directions. It is necessary to render the mercuric chloride remaining in the catgut after sterilization inert as regards its action upon the bacteria used. To do this I introduced the ligatures into test tubes containing sterile water, and conducted into this through a sterile glass tube the gas obtained by heating ammonium sulphide. The mercury remaining in the ligatures was precipitated as a sulphide which is inert in its action on bacteria. This was afterwards washed out in sterile water and the ligatures were finally placed in *bouillon* tubes and these put in the laboratory incubator. The table which follows shows the results obtained. I will briefly state here the method used by me in obtaining resistant spores. The bacteria used were obtained from the Bacteriological Laboratory of the Johns Hopkins Hospital through the kindness of Dr. Harris.



I chose the following bacteria, *i. e.* *Bacillus Anthracis*, *Bacillus Subtilis*, *Bacillus Megatherium* and a resistant *Potato Bacillus*. The latter was one which grew on some of my potatoes after the usual sterilization. These bacteria were placed upon slant-agar and potato and allowed to grow for three or more days at a temperature 28°-30° C. Coarse silk threads, which were used in the tests as more convenient than catgut, were rubbed thoroughly into the cultures which invariably contained numerous spores and were then subjected to the sterilizing processes. After neutralizing or washing out the chemical ingredients used in the various methods the sutures were dropped into bouillon tubes and these were placed in the incubator. In most of my experiments no effort was made to keep the bacteria apart and in some cases I was satisfied to obtain a growth which contained at least one of the bacteria used. However, as shown in the tables, I did in some cases use pure cultures of the bacteria. This can be seen by referring to the tables where the microorganisms are indicated by the first letter of their names, as A—Anthrax, S—Subtilis, P—Potato Bacillus and M—Megatherium. A glance at the following table will show that in every trial of the method a growth was obtained from the sutures which had been subjected to Schäffer's sterilizing process. In four tests, where I used anthrax alone, this microorganism was obtained in pure culture. The method must in consequence of these results be regarded as thoroughly unreliable. Anthrax in catgut has caused in more than one reported case a fatal infection. Within the past six months a Chicago surgeon has told me of two of his patients who were operated upon the same day, dying of anthrax infection which was caused by the catgut used in the operations.

## SCHÄFFER'S METHOD.

Date.	Bacteria.	Result.
April 12th...	A. S. P. M. Growth.	
" 19th...	" Growth.	(Anthrax and subtilis isolated.)
" 24th...	" Growth.	
No. 1. " 27th...	" "	
No. 2. " " "	" "	
" 28th...	" "	(Anthrax and subtilis isolated.)
May 4th...	" "	
" 15th...	A. "	(Pure culture of anthrax.)
" 24th...	A. "	(Pure culture of anthrax. Animal inoculation.)
" 26th...	A. "	(Pure culture of anthrax. Animal inoculation.)
June 11th...	A. "	(Pure culture of anthrax. Animal inoculation.)

*Kossmann's Method.*—Kossmann takes ordinary catgut and immerses it in a 2 per cent formaldehyde solution for 24 hours. It is then washed two or three times in Tavel's solution: Sod. Chlor., 7.5 parts; Sod. Carbon., 2.5 parts; Dist. Water, 1000 parts; with gentle shaking to remove the formaldehyde. The catgut is kept in the same solution. He claims that the catgut is sterile, strong, and swells very little. Schäffer tested this method repeatedly and asserts as a result of his experiments that the catgut is not certainly sterile. The method has so much to recommend it in its simplicity that I

tested it thoroughly. The catgut loses considerably in strength, swells to a certain extent and my bacteriological tests, while at times negative, showed enough positive results to prove that one cannot recommend the method. Schäffer made the assertion that the reason that Kossmann and Vollmer, who recommended the method, got negative results when testing the method bacteriologically was because they did not neutralize the formalin, and enough of this remained in the threads to inhibit the growth of the bacteria or the development of the spores. He took some sutures, which had been inoculated with resistant bacteria, subjected them to the action of formalin and placed them without this neutralization in bouillon. They remained in this media eight days without the development of the bacteria. He then neutralized the formalin with dilute ammonia and the bacteria readily developed. In the experiments given in the following table the formalin remaining in the sutures was neutralized by means of ammonia gas driven off by heating aqua ammonia and conducted into the test tube through a sterile bent glass tube.

## KOSSMANN'S METHOD.

Date.	% Formaldehyde.	Time exposed to formalin.	Bacteria.	Result.
April 14th...	2%	24 hours.	A. S. M. P.	Negative.
" 19th...	2%	24 "	"	Negative.
" 20th...	2%	24 "	"	Growth.
" 25th...	2%	24 "	"	"
" 28th...	2%	24 "	"	"
May 1st...	{ 2% 4%	{ 24 " 24 "	"	"
" 3rd...	{ 2% 4%	{ 24 " 24 "	"	Negative.
" 16th...	{ 2% 4%	{ 24 " 24 "	"	Growth.
" 22nd...	{ 2% 4%	{ 24 " 24 "	"	Negative.
" 22nd...	{ 2% 4%	{ 24 " 24 "	A. S.	{ Negative. "
" 22nd...	{ 2% 4%	{ 24 " 24 "	A. S.	{ " "
June 9th...	4%	24 "	A. S. M.	"
" 12th...	{ 2% 4%	{ 24 " 24 "	A. S.	{ Growth. Negative.
" 19th...	{ 2% 4%	{ 24 " 24 "	A. S. M.	{ Growth. Negative.
" 21st...	2%	24 "	A.	Negative.
" 23rd...	2%	24 "	A. S. M.	Growth.
" 26th...	2%	24 "	"	"
" 29th...	2%	24 "	"	Negative.
July 7th...	2%	24 "	"	"

I tried, in addition to the above experiments, dipping the threads in oil after inoculation and before sterilization, and in every instance got positive results. This was to be expected as the oil prevented the formalin from coming in contact with the bacteria. It is an additional objection to Kossmann's method. As a result of my experiments the sterilization of catgut by this method I regard as untrustworthy and therefore should not be employed.

*Sweetnam's Method.*—Sweetnam's method consists in heating the catgut in sweet almond oil containing 10 per cent of carbolic acid over a water bath at a temperature of 212° F. for one hour, and preserving the catgut in the same solution. The method has much to recommend it in its simplicity and the short time required in carrying it out. I give the table of tests below. One will notice that some of the tests gave

positive results, and if I could have found some means of neutralizing all of the carboic acid or freeing the threads from the carbolized oil there would undoubtedly have been more. Attempts to wash the oil which contained the carboic acid from the silk were to a large extent futile, and a sufficient quantity of the antiseptic probably remained in every instance to inhibit to a certain extent the development of the spores. Leaving this out of consideration a sufficient number of positive results were obtained to make us regard the method as unreliable.

#### SWEETNAM'S METHOD.

Date.	Bacteria.	Treatment to rid threads of carbolized oil.	Results.
June 1899.	A. S. M.	3 rinsings in sterile water.	Negative.
" 13th..	"	4 " " "	Growth.
" 14th..	"	4 " " "	Negative.
" 22nd..	"	Allowed to stand 24 hours in sterile water; rinsing.	Growth.
" 26th..	"	24 hrs. in water, and 3 rinsings.	Growth.
" 28th..	"	24 " " " "	Negative.
July 5th..	P. A. S. M.	1 rinsing in $\text{NH}_4\text{O}-3$ in sterile water.	Growth.
" 6th..	"	2 rinsings in $\text{NH}_4\text{O}$ and 1 in sterile water.	Negative.
" 8th..	"	2 rinsings in $\text{NH}_4\text{O}$ and 3 in sterile water.	Negative.

I did not make as many tests of this method as of the others because I could not find a satisfactory method of freeing the sutures from the oil.

*The Dry Heat Method.*—This method was originated by Reverdin and used subsequently by Döderlein, Benckiser, Boeckmann and others. It consists in heating the catgut slowly in a dry air sterilizer to  $150^\circ \text{C}$ ., and keeping it at this temperature for 2 hours. I found it very difficult with an ordinary laboratory sterilizer to regulate the heat, and the catgut was apt to lose its strength. Schäffer had no criticism to offer so far as the bacteriological provings were concerned, and my experiments, as can be seen in the table, were satisfactory. The catgut was not as strong and pliable as the Cumol catgut and the method requires closer attention unless one has a better method of regulating the heat than can be had with an ordinary dry air sterilizer. The following table shows the time of drying and the temperature at which the sutures were heated:

#### THE DRY AIR METHOD.

Date.	Time of drying.	Time of heating.	Bacteria.	Results.
July 3	3 hrs. to $140^\circ \text{C}$ .	$\frac{1}{2}$ hr. at $140^\circ \text{C}$ .	A. S. P. M.	Growth.
July 5	1½ hrs. to $140^\circ$	$\frac{1}{2}$ hr. at $140^\circ$	"	"
July 6	1½ hrs. to $140^\circ$	1 hr. at $138^\circ-142^\circ$	"	Both negative.
July 8	1½ hrs. to $140^\circ$	1 hr. at $138^\circ-140^\circ$	"	Growth in both.
July 7	$\frac{1}{2}$ hr. to $140^\circ$	30 mins. at $140^\circ$	"	"
July 10	2 hrs. to $140^\circ$	1 hr. at $138^\circ-143^\circ$	"	"
July 12	3 hrs. to $140^\circ$	3 hrs. at $138^\circ-140^\circ$	"	Both negative.
July 13	2½ hrs. to $140^\circ$	1½ hrs. to $138^\circ-147^\circ$	"	"
July 14	3 hrs. to $140^\circ$	4 hrs. to $140^\circ$	"	"
July 15	2 hrs. to $140^\circ$	1½ hrs. at $135^\circ-140^\circ$	"	"
July 21	1 hr. to $140^\circ$	2 hrs. at $140^\circ-145^\circ$	"	Growth in one.
July 22	2 hrs. to $140^\circ$	2½ hrs. at $140^\circ-143^\circ$	"	Both negative.

One sees that in the above experiments in almost every case where the threads were heated for 2 or more hours at a temperature above  $140^\circ \text{C}$ . the threads remained sterile. Reverdin's method calls for 2 hours at  $150^\circ \text{C}$ . The method must therefore be regarded as satisfactory from a bacteriological standpoint.

*The Cumol Method.*—The Cumol method of catgut sterilization first used by Krönig and modified by Clark and Miller proved to be perfect as regards its germicidal properties, and when properly carried out gave strong, pliable catgut. I give here an account of the method as used in the Johns Hopkins Hospital and append a table of bacteriological provings: "Cut the catgut into desirable lengths, 35-40 cm., wind it into small coils or rolls each containing eight to ten strands (It should not be tied or only loosely). It is then heated slowly (at least two hours) to  $85^\circ \text{C}$ . in a dry air sterilizer and kept at this temperature approximately for two hours. After thorough drying it is placed immediately in a metal vessel containing Cumol (which should cover the catgut), and this is heated over a sand bath to  $160-165^\circ \text{C}$ . and kept at this temperature for one hour. The Cumol is then decanted and the excess left in the catgut is evaporated by leaving the vessel over the sand bath for one hour longer, the flame having been removed. The rolls of catgut are then placed in wide-mouthed sterile test tubes, a few rolls in each tube, and these are kept in a covered vessel and used as desired. A convenient apparatus has been devised by Clark which could be improved by leaving off the glass indicating tube. The principal points to be observed are as follows: the catgut must be perfectly dried before subjecting it to the high temperature of boiling Cumol, and care must be taken that the vapor of the Cumol, which is heavier than air, does not come into contact with the flame or red hot metal. If the catgut is not perfectly dried it will become brittle on boiling. To prevent the Cumol from taking fire the sand bath must be a wide one, extending at least 3-4 inches beyond the flame on all sides, and the vessel containing the Cumol should have a tightly fitting top with a corked opening for the thermometer, and an escape tube, by means of which the gaseous Cumol can be conducted away from the flame. Any device by which the vapor is prevented from rolling over the sides of the vessel will answer. It is well to place the catgut before drying in a suitable wire basket and surround it with filter paper. The basket with its contents is transferred from the drying apparatus to the Cumol. This device prevents the catgut from coming in contact with the sides of the metal vessel. The method of Cumol sterilization has been used for five years in the Gynecological Department of the Johns Hopkins Hospital with perfectly satisfactory clinical results. The objections to its use are the time and care required in carrying it out. The cost is relatively small, as very little Cumol is lost each time and the liquid can be used repeatedly."

The No. 3 catgut, the heaviest used by us, is completely absorbed in the skin in ten days and loses largely its strength in 6-7 days. For ordinary purposes this time is sufficiently

long, but in the closure of herniæ, abdominal incisions, etc., a longer time of absorption is desired. I have taken advantage of the well known fact that catgut soaked in formalin requires a longer time for absorption to overcome this objection. The No. 3 catgut is soaked in a 4 per cent formaldehyde or a 10 per cent formalin solution for ten hours; it is then washed several hours in running water, dried, and sterilized by the Cumol method. Catgut so treated is as strong as ordinary catgut and rougher on its surface, which is no objection in tying. I have tested the time required for its absorption in a large number of cases during the past eight months and find it to be from 14-18 days. By using stronger solutions of formalin or by exposing the catgut longer to its action this time can be increased. If soaked too long or if the formalin is not thoroughly washed out the catgut loses in strength. My method is, to take the large rolls of catgut as they come from the dealer, cut the silk threads which bind them, place them on a cylinder which they fit loosely, and soak them in the formalin. After ten hours they are removed from the formalin and placed in running water over night. They are then wound on a loose, wide gauze roller bandage and dried in the sun or before a hot air draught. The process after that is the same as described in the Cumol method.

The following table shows how absolute the sterilization

is in the "Cumol Method." The method calls for one hour at the required temperature, while in every instance in ten minutes the same bacteria which were used in the other experiments were completely destroyed. Until some simpler method is discovered which gives equally as good bacteriological results the "Cumol Method" is the one to be recommended. All methods which depend upon chemical agents must be looked upon in a critical manner. Numerous ones are in every day use which a careful bacteriological test would condemn, and no surgeon should accept any method of sterilization, however much it has to recommend it in its simplicity, unless it is above criticism from a bacteriological standpoint.

Date. 1899.	Bacteria.	Time of sterilization.	Results.
May 24th.....	A. S. M.	30 mins.	Sterile.
" 25th.....	"	30 "	"
" 26th.....	"	30 "	"
" 27th.....	"	25 "	"
June 1st.....	"	15 "	"
" 9th.....	"	25 "	"
" 12th.....	"	20 "	"
" 20th.....	"	15 "	"
" 22nd.....	"	10 "	"
" 23rd.....	"	10 "	"
July 15th.....	"	10 "	"
" 20th.....	"	10 "	"

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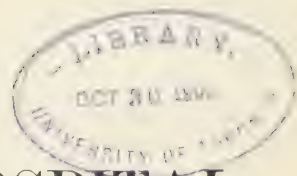
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## ON THE ETIOLOGY OF TROPICAL DYSENTERY.<sup>1</sup>

BY SIMON FLEXNER, M. D.,

*Professor of Pathology, University of Pennsylvania.*

There are few subjects in medicine that have attracted more attention than dysentery. Its history dates from the earliest written records and its ravages, unlike those of many of the pestilential diseases, have continued practically unaltered to the present day. The most ancient writing upon medicine—the papyrus Ebers—contains allusions to dysentery; the oldest Indian medical writers refer to it under the name "Atisar," while Herodotus speaks of its prevalence in Thessaly. Hippocrates, however, was the first to regard dysentery as an independent disease. I should hesitate to bring before this audience a subject so time-worn were it not for the fact that the nature and more especially the etiology of dysentery are among the problems that still await a satisfactory solution. Although the destructive epidemics which characterized the appearance of the disease in ancient times, and which were not unknown even as late as the last century, are in our own day encountered only as accompaniments of war and famine; nevertheless, dysentery still occurs in epidemic form in many Eastern and Western countries, while in the tropics the disease—not unlike cholera, another infectious disorder, the characteristic lesions of which are situated in the intestines—would seem to have found an endemic home.

Our imperfect knowledge of the nature of dysentery should be ascribed neither to lack of opportunity for the study of the disease nor to lack of energy in its pursuit. The literature contains some of the most distinguished names among clinicians and investigators, thanks to whose efforts its clinical history, its epidemiology, and, to a less extent, its pathological anatomy have received partial elucidation. Nor has the disease, in the past quarter of a century, escaped the attention of the bacteriologists, although it must be confessed that the results of somewhat extensive studies along these lines have been far less conclusive than might have been expected. Given a disease that is never entirely absent from temperate and tropical regions, that appears with epidemic severity, that permits of easy access to the *materies morbi*, one would certainly have been tempted to predict that the success achieved in so many other and apparently no less difficult fields, would probably be repeated. That the attempt to establish a common etiological factor for all cases of dysentery has thus far failed, this audience need not be reminded. That this failure has tended to emphasize the existence of several pathological states, for which the term dysentery is employed merely as the collective designation, need not be maintained here. But that these conclusions regarding the disease may after all not be in keeping with the facts is at least open to suspicion. When we recall the protean nature of other infectious diseases,

<sup>1</sup> Middleton-Goldsmith Lecture. Delivered before the New York Pathological Society, April 12, 1900.

among the most common of which are tuberculosis and typhoid fever, there can be no *a priori* objection to the hypothesis that the causative agent of dysentery need not necessarily vary for each of the many types of the disease that have, from time to time, been distinguished.

For the purpose of my inquiry, I shall consider briefly the clinical and pathological types, after which I shall ask your attention to the evidence for belief in specific causes. In considering this topic I shall endeavor to bring out the bearing of such studies upon dysentery in general and upon particular types of the disease. Finally, I shall hope to emphasize certain considerations connected with the etiology and pathology of dysentery by reciting some observations made upon the dysenteries prevailing in the Philippine Islands.

*Types of Dysentery.*—That the lines of demarcation between the several clinical and pathological types should be inaccurate is not a matter of wonder. Both the beginning and end of any given instance may vary widely, and the symptoms and lesions of cases arising sporadically in temperate climates may agree with those of dysentery occurring endemically in the tropics or epidemically in both localities. The terms "catarrhal," "tropical," "epidemic," and "diphtheritic," are far from signifying sharply-defined entities. The clinical manifestations and pathological lesions of the catarrhal variety occur in all kinds of dysentery and in all places where the disease prevails. Ever since the time of John Hunter there have been those who, upon pathological-anatomical grounds, have separated the endemic from the epidemic disease, and the line has been even more sharply drawn during the past decade, since the discovery of the *Ameba coli* in its relations to tropical dysentery. But the distinction between tropical dysentery and the epidemic disease is far from being sharp and constant. Diphtheritis and ulceration are not safe criteria. For while the former is commonly present in the epidemic disease, it occurs also in the tropical malady, and may, according to Kartulis, be associated with the ulcerative amebic variety, in which the lesions begin with destruction of the submucous coat of the gut.

As must always occur when classification of a disease proceeds upon clinical and pathological rather than etiological lines, the literature of dysentery is burdened with an interminable mass of appellations indicating the nature of the disorder or the author's conception of its pathological anatomy. Dysenteries, however, are now divided by the chief writers into several groups, depending upon the clinical history or the mode of prevalence. Thus Osler writes of 4 varieties, the acute catarrhal, the tropical or amebic, the diphtheritic, and the chronic dysentery. Davidson considers the subject under 2 headings: (1) according to prevalence—epidemic, endemic, the dysentery of war and famine; (2) upon clinical grounds—acute fibrinous or pseudodiphtheritic, and chronic dysentery. Kartulis describes endemic, epidemic and sporadic varieties; Manson speaks of a catarrhal and ulcerating dysentery, while Delafield distinguishes in the environs of New York at least 5 distinct types of this disease, only one of which would appear to be due to a specific agent—the *Ameba coli*.

*Evidences for Specific Causes. Bacteria.*—The presence of bacteria in the stools and tissues in dysentery was demonstrated by Klebs, Prior and Ziegler, whose studies, carried out upon the epidemic disease, have now only a minor historical interest, although Ziegler still holds that the relations of certain bacilli to the lesions speak for their pathogenic action. The early studies of Hlava upon the epidemic disease yielded quite inconclusive results, since, although he was able to obtain as many as 19 different kinds of bacilli in cultures, inoculations into animals failed entirely to reproduce the morbid process. Chantemesse and Widal were somewhat more fortunate. From five cases of tropical dysentery they obtained a bacillus which, when injected into the stomach or rectum of guinea-pigs, gave rise to diphtheritis, an observation which Grigoriew, who believed that he had isolated the same microorganism from 10 cases of dysentery, failed to confirm.

Maggiari, who studied 11 cases of the epidemic disease, obtained *B. coli communis* regularly and in large numbers. Less frequently *B. proteus vulgaris* was isolated, while in some cases the pyogenic cocci and *B. pyocyaneus* were found. This investigator considered it highly probable that the disease was caused by a *Bacillus coli* of intensified virulence—a conception also shared by Laveran, Arnaud, Celli and Fiocca and Escherich, who isolated the same organisms from dysenteric cases. Arnaud's series was larger, embracing 53 acute cases occurring in Tunis, from all of which *B. coli* was isolated. The spleen of a fatal case also yielded him the organisms. The ingestion of cultures in the case of several kinds of animals gave no results; while rectal injections of bouillon cultures, previously raised to 60-80° C., produced in two dogs a fatal and characteristic dysentery—a result in striking opposition to those reported by other writers.

The studies upon this bacillus by Celli and Fiocca are the most important which we possess. Their cases numbered 62 and included examples of the sporadic, epidemic, and tropical disease occurring in Italy and Egypt. From the fact that especial attention was paid to the occurrence and action of the *Ameba coli*, the results of these authors are doubly useful. They exclude this organism as the cause of any form of the disease and consider that a variety of the colon-bacillus, of especial virulence, which they designate *B. coli dysenteriae*, is responsible for the lesions. Along with this colon-bacillus they found typhoid-like bacilli and streptococci. Their experiments upon animals are also more conclusive than any others. With cultures they were able to produce dysentery in cats, and while they admit that other microorganisms were also capable of producing similar results, they found that the latter acted far less constantly than their dysenteric bacillus. A toxin separated from growths of the organism was found to give rise to similar conditions. Celli, in another publication, expresses the view that it is this toxin that first exerts an injurious effect upon the intestinal mucosa, after which the destructive lesion is produced by the pyogenic cocci. Results similar to those of Celli were obtained by Del Pino and Alessandri. The latter, working on a case of postoperative dysentery, secured cultures of *B. coli* that yielded a toxin



capable of setting up dysentery in young cats. In their most recent paper, Celli and Valenti describe the production in dogs of sera, which, when tested upon experimental animals, exert a protective and healing effect. Upon human beings its action was not equally positive.

The colon bacillus is also believed by Escherich to play an important part in the production of a contagious enteric disorder (colitis contagiosa) in children. In its morbid anatomy the disease agrees with catarrhal dysentery.

The bacilli thus far enumerated, except those of Chantemesse and Widal, so far as they could be studied in cultures, have shown no specific properties. They all represent a well-known bacterial species, constantly present normally in the situation from which the organisms were obtained in disease, and whose only unusual properties were increased virulence when tested upon animals, and a capacity to set up enteritis when injected into the intestines of dogs and cats.

The investigations of an epidemic of dysentery which prevailed in Japan yielded different and apparently more convincing results. Ogata isolated fine bacilli, which liquefy gelatin, stain by Gram's method, and set up, when introduced by the mouth or by the rectum into guinea-pigs and cats, intestinal ulcerations. The organism regarded by Ogata as the cause of epidemic dysentery was isolated from 23 cases of the disease occurring in Padua by Vivaldi. Since that time it appears not to have been found again.

This list does not entirely cover the bacillary species isolated from cases of dysentery. The recent publication of Shiga, who also studied the disease prevailing in Japan, is needed to complete the number. But as this investigator's studies have a very direct bearing upon my own, I shall defer speaking of them for the present.

On the other hand, a causative rôle in the production of dysentery has also been ascribed to the pyogenic cocci. Besides being found in association with bacilli, by several of the investigators already mentioned, they have been regarded as the chief pathogenic agents by Zancarol, whose studies were carried out in Alexandria, by Silvestri of Turin, by Bertrand and Baucher of France, and very recently by Ascher, who investigated cases arising in Eastern and Western Prussia. These cocci, especially the streptococci, were capable in certain instances (Silvestri, Ascher) of setting up, in cats, dysentery, and liver-abscess. The cocci isolated by Ascher were also said to have shown the agglutination reaction with the blood-serum of the patients from whom they were obtained. As a cause of a special variety of endemic dysentery—the endemic enterocolitis of Cochin China—Calmette obtained the *Bacillus pyocyaneus*. The same microorganism was isolated, from a small epidemic of the disease occurring in New York State, by Lartigau, in another epidemic in children, prevailing in Canada, by Adami, and in certain sporadic cases of gastric and enteric infection, by L. F. Barker in Baltimore.

**Protozoa.**—Because of the great diversity of the normal intestinal flora the varieties of bacteria which can be isolated from the dejections and intestinal contents are relatively

numerous. The differences in the numbers and kinds of bacteria capable of flourishing there, rendered possible by the existence of pathological conditions, readily account for many of the results of the bacteriologic studies given. With animal microparasites the case is different. Protozoa do not exist in easily demonstrable forms or numbers in the dejecta in health, and the number of species occurring under all conditions is small. Of these the list is confined to a few kinds of flagellates—which even when present in considerable numbers do little harm—and the amebæ.

It is to the rôle of the amebæ—a particular variety of which has achieved the distinction of being connected in a causal relation with endemic dysentery—that I wish to direct your attention. Since the studies of Kartulis, Councilman and Lauleur, and Kruse and Pasquale, so firmly has the idea of this connection taken hold of the popular medical mind, that the designation “amebic” as synonymous with “endemic” or “tropical” dysentery has been widely adopted. And yet the evidence upon which this belief is based cannot be regarded as convincing. Until we shall have gained means of differentiating amebæ other than those we now possess, and, moreover, until we are able to control their development with at least as great perfection as in the case of bacteria, the question of the precise part played by them in dysentery cannot be satisfactorily determined.

Since the historical observation of Lambl upon the occurrence of amebæ in the dejections of human beings, and especially since the confirmatory observations of Cunningham, Lewis and R. Koch, our knowledge of the distribution of these organisms in human beings has constantly widened and deepened. It was, moreover, the study by Lösch of a case of dysentery in which an ameba, called by him *Ameba coli*, occurred that gave the impulse to the investigation of the pathological actions of such organisms.

The importance of amebæ was further enforced by the demonstration of the organisms in sections of dysenteric ulcers by R. Koch, first in Egypt and afterwards in India. Following these successes, and probably directly through the suggestion of Koch, Kartulis began his series of observations and publications, which more than any other similar writings have tended to isolate tropical dysentery and place it upon a probable etiological basis.

The work of Kartulis need not be reviewed in detail in this place. His conclusion that in every undoubted case of dysentery occurring in Egypt the amebæ are present, has not been entirely confirmed. That they are, moreover, never present in the intestines in other enteric diseases and in health has also not been the experience of all other investigators. But that amebæ are abundant in many cases of tropical dysentery and may also be demonstrated in the contents of the hepatic abscess in the disease, the studies of Kartulis and those of subsequent investigators have definitely shown.

To follow the list of discoveries in cases of dysentery which have accumulated in the last decade is unnecessary and would carry us too far afield. Reports confirmatory of the results of Koch and Kartulis have appeared from many European

countries, the Pacific Islands, and from both North and South America. Ten years have, however, seen a modification of the views regarding amebæ, as causes of pathological conditions in human beings. The demonstration of amebæ, indistinguishable from the *Ameba coli*, in various intestinal diseases and even in healthy persons, has necessitated a recasting of the exclusive belief in their pathogenicity and relation to dysentery.

That amebæ may exist in diseases other than dysentery was conclusively proven by the early observations (Cunningham, Lewis) upon choleraic discharges. More important results were obtained by Grassi, first in 1882 and later in 1888. He describes amebæ which may occur, in considerable numbers, in diseases as varied as typhoid fever, cholera, pellagra, and colitis secondary to tumors. He demonstrated their presence in diarrheas and dysenteries, but at times also found them in the dejecta of healthy individuals. That amebæ can exist in the intestines without any disturbance of the health of their host was, therefore, definitely established by Grassi's observations as well as by those of Calandrucci, Massiutin, Kruse and Pasquale, Gasser and Schuberg. The observations of the last-named investigator are especially valuable, in that he showed that to the reaction of the lower colon and the consistence of the feces was due the fact that amebæ could not be constantly found with comparative ease in the dejecta. If a laxative, as for example, Carlsbad salts, is administered and the contents of the upper colon are then collected and examined, amebæ are frequently demonstrable. Moreover, under these conditions flagellates—the trichomonas and cercomonas—appear in the stools. He looks upon these parasites as common commensals in man.

It can, therefore, no longer be held that amebæ are necessarily pathogenic when found sojourning in the intestine in man. Indeed, the necessity of recognizing distinct species of amebæ had already begun to force itself upon thoughtful students, who until lately believed in their constant pathogenic action. Quincke and Roos, who observed amebæ first in a healthy individual, and later in two widely dissimilar cases of enteritis, tested the different organisms concerned for pathogenesis upon cats. From their results they believed that according to certain structural differences, and the action of the parasites in engulfing red blood-corpuscles, two main varieties or species can be distinguished, the one phagocytic for red blood-corpuscles and pathogenic for man and cats—this species being identical with the *Ameba coli* of Lösch—the other, nonpathogenic and nonphagocytic for blood-corpuscles, which they designate *A. coli mitis*. According to this view *A. coli*, *A. felis*, and *A. dysenteriae* of Councilman and Laflaur are all one species; *A. coli mitis* a harmless saprophyte, or at least is one of relative pathogenic insignificance.

It requires no elaborate argument to bring out the fallacies of such a method of distinction. Results following the introduction of so complex a material as dejecta into an animal cannot be accepted as deciding the properties of any single constituent. What has already been said concerning the ability of pure bacterial cultures to produce enteric lesions affords a sufficient criticism of such a procedure.

That amebæ when combined with bacteria may cause intestinal lesions and even ulceration is now established. Furthermore, the experiments of Kartulis and Kruse and Pasquale with the contents of hepatic abscesses, supposed to be free from bacteria, are all but convincing, in so far as they may be supposed to prove the capacity of amebæ alone to set up such changes.

The attempt to cultivate the *Ameba coli* without admixture of bacteria has in all probability never yet been successfully carried out. The supposed positive experiment of Kartulis is now known to have been erroneous. Whether Celli and Fioeca have succeeded is still doubtful. In any case no satisfactory experimental production of amebic dysentery in cats or other animals has thus far been achieved with cultures of amebæ free or relatively free from bacteria.

The pathological findings in amebic dysentery have been adduced as proving its specific character by Councilman and Laflaur, Kruse and Pasquale and Kartulis. According to this view the intestinal ulcers in amebic dysentery begin as in infiltration of the submucous coat that leads to necrosis of the overlying membrane. The lesions, unless complicated by the presence of bacteria, are free from the products of purulent inflammation. The accompanying abscess of the liver exists independently of the presence of bacteria. Kruse and Pasquale, and Kartulis ascribe greater significance to bacterial association than do Councilman and Laflaur. Kartulis sees in the occasional diphtheritis evidence of their action, while Kruse and Pasquale have followed them in their penetration into the coats of the gut, where they lie side by side with the amebæ or even precede them in the invasion. Both bacilli and cocci occur; and wherever necrosis is found, bacilli are sure to occur in groups and masses. "The amebæ and bacilli together start the lesions in the intestine." (Kruse and Pasquale.)

The form of lesions here described does not entirely represent the disease as it appears in the tropics. Even Laflaur in a later communication says that the term "tropical" can be used only as a partial synonym for amebic dysentery, inasmuch as, on the other hand, the disease, though more frequent in the tropics, is by no means limited to those regions, while, on the other hand, there are undoubted cases of dysentery in the tropics which are not of the amebic form—a statement borne out by my own observations.

How far, then, have the foregoing results aided us in clearing up the hitherto obscure etiology of this protean malady? While epidemic, endemic, and sporadic dysentery have been subjected to bacteriological investigation, the chief work thus far done has been with the tropical variety. Although the actual number of cases of the epidemic disease which have been carefully studied is small, it is significant that, with two exceptions—the studies of Ogata and Calmette—the several different microorganisms isolated have all been bacteria which are normally present in the intestinal canal. The cultures have, it is true, undergone changes of virulence, but in other respects they have retained their ordinary biological and physiological properties unaltered. It would certainly seem *a priori* highly improbable that so severe and devastating a

disease as epidemic dysentery should be due to microorganisms which are constant inhabitants of the intestinal tract. Moreover, when it is recalled how easily and under what great variety of conditions such accessions of virulence may be achieved, it would be remarkable that epidemics of dysentery are, nevertheless, relatively rare phenomena.

Turning to the tropical disease, we also observe that several microorganisms have been assigned as the causative agent. Chantemesse and Widal have described a bacillus not obtained since from similar cases; Arnaud, Laveran, and Celli and Fiocca have seen in the colon-bacillus, modified in its pathogenicity, a sufficient cause. More weight, and with far greater justice, has been laid upon the *Ameba coli*. But this organism has been found more especially in chronic cases. Kartulis states that the catarrhal stage, which is common in the epidemic and sporadic disease, is uncommon in this form. If the *Ameba coli* is the organism most commonly present in the acute dysenteries of the tropics, the fact has not yet been conclusively established. However this may be, in Manila, where the organism is not infrequently present in the chronic disease, its absence in the very acute and often rapidly fatal cases of dysentery must be regarded as of significance.

From the preceding considerations the following conclusions seem warranted:

1. No bacterial species yet described as the cause of dysentery has an especial claim to be regarded as the chief micro-organism concerned in the causation of the disease.
2. It is unlikely that any bacterial species that is constantly and normally present in the intestine or in the environs of man, except where the disease prevails in an endemic form, can be regarded as the probable cause of epidemic dysentery.
3. The relations of sporadic to epidemic dysentery are so remote that it is improbable that the two diseases are produced by the same organic cause.
4. The pathogenic action of the *Ameba coli* in many cases of tropical, and in certain examples of sporadic, dysentery, has not been disproved by the discovery of amebæ in the normal intestine and in diseases other than dysentery. While amebæ are commonly present and are concerned in the production of the lesions in subacute and chronic dysentery, they have not thus far been shown to be equally connected with the acute dysenteries even in the tropics. In the former varieties, bacterial association probably has much influence upon the pathogenic powers of the amebæ.

#### THE DYSENTERY OF JAPAN AND THE PHILIPPINE ISLANDS.

Every year, especially in the summer and autumn, dysentery prevails in Japan. Ogata and Eldridge have given the statistics of incidence and mortality in the years from 1878 to 1899:

Year.	Cases.	Deaths.
1878.....	1,118	206
1879.....	8,322	1,487
1880.....	5,047	1,305
1881.....	7,001	1,837
1882.....	4,330	1,313
1883.....	21,172	5,066

Year.	Cases.	Deaths.
1884.....	22,702	6,036
1885.....	47,377	10,690
1886.....	24,328	6,839
1887.....	16,125	4,244
1888.....	26,789	6,570
1889.....	22,893	5,970
1890.....	42,632	8,706
1891.....	46,358	11,208
1892.....	70,842	16,844
1893.....	167,305	41,282
1894.....	155,140	38,094
1895.....	52,711	12,959
1896.....	85,876	22,356
1897.....	91,077	23,189
1898.....	90,933	22,379
1899.....	125,989	26,709
	1,136,067	275,289

The epidemic studied bacteriologically by Ogata occurred in the province of Oita where in 1890, 801 cases occurred with 221 deaths, and in 1891, 8390 cases with 2163 deaths—an average mortality of from 26 to 27 per cent. This epidemic had been preceded by sporadic cases in the previous winter, and in its spread showed a striking contagious character. The lesions in the intestine are described in one case, death having taken place on the eleventh day of the disease. The lower segment of the small intestine was hyperemic. The large intestine was greatly swollen so that the lumen was almost obliterated. The mucosa membrane was hyperemic and presented a deep bluish-red color. The contents were chocolate-colored. The mucosa of the transverse and descending colon, and especially of the sigmoid flexure, showed small ulcers, the size of peas, which were so numerous as to give to the membrane a sieve-like appearance. They were also found, though in smaller numbers, in the descending colon and rectum. No large ulcers were present. The peculiar bacilli—staining by Gram, liquefying gelatine, and causing in animals, whether injected beneath the skin or into the rectum, hyperemia and ulceration of the intestinal mucosa—have been already described. Ogata's decision was that the bacillus isolated was probably the cause of the epidemic of dysentery prevailing in Southern Japan.

I am not acquainted with a full description of the morbid anatomy of the dysentery prevailing in Japan. Schaube formerly of Tokio, in his "Die Krankheiten der warmen Länder," does not give a detailed account of the Japanese variety, but contents himself with the usual classification and description of the disease. The meager accounts may possibly be explained by the fact that necropsies are obtained in Japan only with great difficulty. Dr. Eldridge states that the lesions seen in "amebic dysentery" as described by Councilman and Laflour are seldom met with. The common lesions are destructive, progressing from the surface downwards, associated with necrosis of the mucosa and croupous infiltration (diphtheritis). Perforation is unusual, the muscular coat offering a strong resistance to the pathological process.



The most recent bacteriological study of dysentery has been made by Shiga, to whose results I would ask especial attention. During 1897 the disease prevailed epidemically in Japan, 89,100 cases with 22,300 deaths (24 per cent) being recorded from June to December. Out of a considerable number of cases occurring in Tokyo, 36 were subjected to bacteriological examination by Shiga.

As was readily recognized by him, four points must be proved in the effort to show that an organism suspected of standing in etiological relation to any given disease is really the causative agent: (1) The organism must occur constantly; (2) it must be a species not present normally in the diseased part; (3) it must be pathogenic and produce in experimental animals lesions similar to those from which it was obtained; (4) it should in virtue of its pathogenic activity in man show the Widal agglutination reaction with the blood-sera of those who have suffered from the disease. From the series of cases examined there was obtained from the dejecta and intestinal contents and walls, and from the mesenteric glands, a bacillus which fulfilled all these requirements and which was regarded as the cause of Japanese dysentery, at least.

Before entering upon a description of this organism I should like to direct your attention to the dysentery prevailing in the Philippine Islands, especially in and around Manila. The report of the Surgeon-General of the Army for 1899 contains a tabulation of diseases, observed among the American troops, during the first four months of the American occupation of Manila. In it the dysenteries are included with the diarrheal diseases. The total number of cases reported is 145, the death-rate being 0.18 per cent. The comment made is that "the malarial diseases exceed their prevalence in the United States in the proportion of 370 to 96, and the diarrheal diseases in the proportion of 445 to 116, or about 4 to 1 in both instances."

This compilation fails to give an adequate idea of the extent, severity, and mortality of dysentery in Manila. Although, unfortunately, figures are not obtainable, I am convinced, after nearly three months' residence in Manila, that the enteric diseases, of which dysentery was the most frequent and important, were the chief causes of disability and mortality among the land forces of the American army.<sup>1</sup>

The disease appears in two main forms, acute and chronic dysentery. The stools and intestinal contents at autopsy were scrutinized for amebæ. So far as regards the acute cases these organisms were absent or very difficult to find in the fresh stools and in the intestinal contents immediately after death. In the chronic forms of the disease ulcers were present in the mucosa and submucosa; the lesions were confined to the large intestine, the coats of which were greatly thickened; at times large sloughs of the mucous membrane, partly detached, were encountered. Amebæ were commonly

present, but were variable as to actual occurrence and numbers. Large hepatic abscesses, usually single, were encountered in a number of these cases. Amebæ were not always found in the contents of these abscesses; sometimes bacteria were present alone or associated with amebæ. Amebæ not distinguishable, except by the absence of specific inclusions, from those in the stools of human cases exist in the dejecta of monkeys liberated from captivity and now at large in Manila.

The morbid anatomy of the chronic disease agrees in part only with that of "amebic" dysentery. I shall draw attention later to another form of the chronic disease.

The pathological changes in the acute cases differ widely from those of the chronic affections. I shall now give in brief the condition of the intestines in several cases of acute dysentery. The patients were American soldiers.

CASE 1.—Death on the sixth day of the disease. The entire large intestine from the cecum to the rectum is dilated and the walls of the gut are thickened. The mucous membrane is swollen, its consistence is much increased and the normal folds are thrown into elevated, coarse corrugations. The general color of the mucous membrane is deep red, but there are present many brighter spots evidently due to hemorrhage. No distinct false membrane is to be made out, but here and there are scattered white elevations, which, after the intestine has been washed, become more prominent and can be removed only with some difficulty, small defects in the membrane being left behind. In the fresh state ulceration was not made out, but after the washing referred to, there are found in the lower portions of the sigmoid flexure minute, sieve-like points, with perfectly sharp edges, representing defects which lead into the submucosa. The smallest of these openings are the size of pin-points, the largest about 2 mm. in diameter. The contents of the intestine showed no amebæ.

CASE 2. Death on the fifth day of illness. The small intestine, excepting the lower end of the ileum, which is deeply congested and swollen, shows no alteration. The serosa over the large intestine is injected, but is otherwise normal. The large intestine is much thickened and its consistence is increased. On opening the gut the contents are found to be dark or nearly black in color, an appearance probably due to the administration of bismuth. The mucous membrane extending from the rectum to the ileocecal valve, and beyond the valve in the ileum for a distance of 4 cm., is congested, swollen, and hemorrhagic. Scattered here and there on the surface are elevated, white, irregular points and small, flattened areas, which suggest a pseudo-membrane, but which cannot be absolutely identified as of such a nature. The normal velvety character of the mucous membrane is lost. No ulceration can be made out and the lesions seem to be chiefly in the mucosa and submucosa. Particularly conspicuous is the wide diffusion of the lesions, no part of the mucous surface within the limits defined having escaped. The mesenteric glands are congested and moderately swollen. Although amebæ had been found in the evacuations two days previous to death, they could not be demonstrated in the intestinal contents at autopsy.

CASE 3.—Death after an illness of 6 days. The large intestine is markedly dilated and the serous coat is much injected. The contents of the large intestine are represented by a grumous, pink, pulpy material. The mucous membrane is swollen and hyperemic, and presents a striking granular appearance due to exudate upon the surface; many areas of hemorrhage are also observed. The entire mucosa of the large intes-

<sup>1</sup>The studies on dysentery here recorded were made by a commission consisting of Dr. L. F. Barker and myself, sent out by the Johns Hopkins University to study the diseases prevailing in the Philippine Islands. To this commission were attached Messrs. Joseph M. Flint and Frederick P. Gay, who were, at that time, members of the Johns Hopkins Medical School.

tine is implicated in this process. Ulceration is not present. The mesenteric glands are swollen, congested, and hemorrhagic. The spleen is moderately enlarged. Amebæ were not demonstrable in the intestinal contents.

The three cases which have been selected do not agree with amebæ dysentery as hitherto described. In only one were amebæ found in the stools, and even then they could not be demonstrated in the intestinal contents, obtained immediately after death, which took place two days after the first examination. The stools consisted, as was the rule in the acute disease observed in Manila, of mucus and blood. The microscopical examination revealed epithelial cells, red blood-corpuscles, a moderate number of bacteria and many amebæ. On the same day injections of quinin were begun, ipecac being administered by the mouth. The note 24 hours later states that the stool contained mucus but less blood. Epithelial cells were still present and the bacteria appeared in greatly increased numbers. No amebæ could be discovered. Death took place on the day of this examination.

In their pathological histology also the acute dysenteries differ from the amebic form. The histological changes appear in the mucous membrane, submucosa and muscularis, being most marked in the former situations. Those of the mucous membrane consist of coagulative necrosis with exudation of fibrin and polymorphonuclear cells. The fibrinous and cellular exudate may entirely replace the glandular layer, or here and there a gland may be preserved. The pseudomembrane is a close-meshed network of fibrin enclosing multinuclear, often fragmented, cells. No blood-vessels are to be distinguished, but a variable number of red blood-corpuscles are mingled with the exudate and lie free upon the surface. The muscularis mucosa is not always distinguishable—indeed it is frequently lost in the exudate. The submucosa is always much altered. From the changes found in it, it is evident that to them is chiefly due the thickening of the gut. The part most affected is the layer next the muscularis mucosa. Here are found hemorrhages of variable size, while in the interstices of the tissues some fibrin appears. More marked, however, are cellular accumulations, which are present, not uniformly, but in irregular areas. The deeper layers of the submucosa show similar cellular infiltrations, although the amount is less striking. On the other hand, at these levels the quantity of fibrin is greatly increased and hemorrhages are numerous.

The character of the cellular exudate is quite uniform. Excluding the red blood-corpuscles, the new cells consist chiefly of plasma cells. These are collected into foci, often about blood-vessels, veins and arteries, but sometimes occur in small groups or singly. There can be no doubt that these are identical with Unna's plasma cells; they show the reticulated nucleus, often placed eccentrically, and the fine blue granulations of cell-protoplasm in eosin and methylene-blue staining. As the deeper levels of the submucosa are reached, hemorrhages and fibrin are abundant. The size of the foci of plasma cells gradually diminishes. At the muscular border they have about disappeared. Among the plasma cells a variable number of eosinophilic cells may be distinguished.

In the submucosa, infiltration, hemorrhage and fibrin-formation take place also beneath an intact or almost intact mucous membrane. The nature of the cellular infiltration may be identical with that already described, but in addition accumulations of lymphoid cells may frequently be seen. These exist in the layer of the submucosa immediately next the muscularis mucosæ; the deeper cells resemble plasma cells.

The blood-vessels of the submucosa may be patent and congested, the blood containing an excess of white elements; or they may show recent leucocytic and fibrinous thrombi. Hyaline degeneration of the vascular walls was not encountered. Large spaces in the submucosa may contain fibrinous clots; these are probably dilated and thrombosed lymphatic vessels.

The muscular coat shows only hemorrhages, which may be of large size, although they are usually smaller than in the submucosa. The peritoneal tunic is usually unaltered.

From this brief description it is evident that the main pathological changes take place in the mucous membrane and submucosa and it is also clear that the 2 tunics may be affected simultaneously or the submucosa may suffer pathological alterations without involvement of the mucosa. So far as could be ascertained from the material studied, in contradistinction to the condition observed in "amebic" dysentery, ulceration did not begin in the submucosa, but any defect which may have occurred resulted from exfoliation of the necrotic mucosa and the attached pseudomembrane.

It is interesting in this connection, to emphasize the fact that the polymorphonuclear leucocyte plays a very insignificant rôle in the process of infiltration in the submucosa, whereas in the affected mucous membrane it is much in evidence. On the other hand, the blood-vessels of the submucosa contain those cells in increased numbers and the cellular and fibrinous thrombi are rich in them. It would appear, therefore, that these cells do not leave the vessels in the submucosa as readily as those of the mucous membrane. That the blood-vessels of the submucosa suffer great injury from the pathogenic agent is shown by the free hemorrhages and the fibrinous exudation.

Bacteria are abundant in the fibrinous exudation in the mucous membrane. The chief varieties distinguishable are cocci and bacilli. In specimens stained by Gram's or Weigert's methods, large numbers of cocci, in short chains and groups, can be made out. In other specimens, stained in Unna's alkaline methylene-blue, besides the cocci many bacilli may be seen. These are quite uniform in size; they present the morphological characters of the colon-typhoid group, from which they could not be distinguished in sections of tissue. While the bacteria are so abundant in the necrotic-mucous membrane, diligent search failed to exhibit either bacilli or cocci in the infiltrated areas of the affected submucosa. The conviction is therefore forced upon one that the lesions in the submucosa are toxic in origin. Amebæ were not discovered in the sections.

#### THE BACTERIOLOGY OF PHILIPPINE DYSENTERY.

In the study of the bacterial flora of the disease acute and

chronic cases were utilized. The methods of procedure varied only slightly in different cases. The acutely ill being in bed, the evacuations were collected in bed-pans, which a short time before had been carefully scalded. The patients who were about the wards were taken to the laboratory, where cultures could be made immediately from the contents of the rectum. The fatal cases were subjected to autopsy immediately after death. The large gut at different levels was burned through with a hot knife, and cultures were made before disturbing any of the viscera. Plate cultures in agar-agar were employed. The average number of plates made from a single case was twelve. The material was mixed with bouillon, so as to afford the advantage of a relatively large amount for plating. It was frequently obtained from several different portions of the evacuation or from several levels of the intestine. Only such plates as contained well-separated colonies were utilized. Control microscopical examinations of the evacuations and intestinal contents were made. It may be mentioned that cercomonads and trichomonads were very common in the diarrheal stools. They did not appear to be of pathological significance.

From the separated colonies, agar-slant cultures were made. The growths of the pyogenic cocci as well as those of *B. pyocyaneus* were not pursued further. The former was never absent, the latter was rarely present. The bacillary colonies, which occurred with regularity in the acute disease, could be distinguished according to two distinct types. Their properties are as follows:

*Type I.*—*Bacillus* of the average size of *B. coli communis*. There is variation in length; almost none in thickness. The individuals are usually separate; sometimes they are united in pairs, but only very rarely do they occur as filaments. The ends are slightly rounded. The bacillus shows moderate motility; Gram's stain is negative.

Growth takes place upon all culture media at the room temperature, but better in the thermostat. Gelatin is not liquefied. The colonies resemble those of *B. typhosus*, being more nearly like them when first isolated from the dejecta than after a period of cultivation outside the body. After many months of such saprophytic growth the colonies become thicker, exhibit a moist surface and are less translucent. The strokes upon agar-slants show a similar alteration. At first the growth extends but little laterally, but later on it becomes 2 to 3 mm. in width, and generally shows distinct indentations at the edges. Upon gelatin the colonies are more delicate; the stab extends along the line of puncture only, spreading very little at the surface of the medium.

On potato, growth takes place along the line of inoculation and spreads beyond. After some days it is a little elevated and of a pale-brown tint. On unfavorable potatoes the growth is slight, moist and membranous, resembling, except for the greater amounts of moisture, that of *B. typhosus* when typical.

Sugars—glucose, lactose, and saccharose—are not fermented gaseously. In glucose media a moderate acid production takes place.

Bouillon is clouded diffusely and a sediment forms. There is no production of a pellicle.

Litmus-milk assumes, after 24 to 72 hours, a faint lilac tinge. After the lapse of from 6 to 8 days alkali begins to be produced, which increases in amount until the litmus is rendered deep blue in color. No coagulation of the milk ensues.

Indol is not always formed. Even in sugar-free bouillon it may fail to appear, or it may be produced in small quantities only.

Suitable cultures of this organism, when tested for the agglutination reaction with the blood-serum of persons suffering from dysentery—the host of another individual—give, in many cases, a positive result.

The bacillus is pathogenic for the ordinary laboratory animals. It is abundant in the acute cases in which it may be the predominating organism; it becomes more difficult to find as the cases progress towards recovery or chronicity. In the ordinary chronic dysentery of Manila, in which amebæ are commonly encountered, it was not found. It can be cultivated from the dejecta during life, and the intestinal contents, mucous membrane and mesenteric glands in fatal cases.

*Type II.*—*Bacilli* which are present in all instances. In the acute cases they may not predominate, being less numerous than the members of *Type I*. In all others it is the predominating bacterium. The properties vary somewhat, but agree well with those of the group *B. coli communis*. The main variations relate to extent and rapidity of growth upon the several culture media, the rapidity with which litmus-milk is reddened and coagulated, and the amount of indol produced. The sugars are broken up with the formation of gas. The morphology is also similar to that of *B. coli*; some specimens are motile at the end of 24 hours; in others motility was not demonstrated.

In agglutination tests the results varied according as the blood of the host or of another individual was employed. With that of the host there was frequently a reaction in low dilutions; with that of another person the reaction was rarely and very inconstantly obtained. The pathogenicity was not tested extensively.

The practical operation of separating the several kinds of bacilli which grew in the plates was to inoculate glucose-agar stab-tubes from the different colonies. In those tubes which, after 24 hours at 37° C., showed no gas, the organisms were likely to conform to *Type I*.

Before proceeding to the assumption that this organism was concerned with the production of the intestinal lesions of dysentery occurring in Manila, it was necessary to establish its absence from the stools of healthy persons and of those suffering from other diseases. Strong presumptive evidence of its being an unusual inhabitant of the intestine of man may be gathered from the facts already known concerning the ordinary intestinal flora. But as such observations would not suffice for a new region and under new conditions, the organism was searched for in other persons who had been in close association with those suffering from dysentery and also in inhabitants of other parts of the Island of Luzon. The organism was not demonstrated in healthy dejecta or in evacuations of persons (native Filipinos) suffering from beriberi. A further argument in favor of its restricted distribu-



tion is furnished by its absence from cases of chronic dysentery or the marked reduction in the numbers present.

**Pathogenicity.**—The pathogenicity of the bacillus Type I was studied, soon after its isolation, upon mice and monkeys in Manila, and upon various animals in this country with cultures brought from the Philippines.

**Monkeys.**—Subcutaneous inoculation gives rise to a swelling from which the animal suffers no inconvenience and quickly recovers. Monkeys which were given croton oil and, after purging had been established, 10 cc. of a bouillon culture through a stomach-tube, soon recovered from the effects of the purge, and no further results could be noted.

**Mice** are susceptible to subcutaneous and intraperitoneal inoculations. Death takes place in from 24 to 48 hours—rarely after several days—the reaction varying according to the dose and the mode of inoculation. The site of puncture shows edema and, in the case of injections made beneath the skin, a hemorrhagic exudate. Inoculation into the peritoneal cavity gives rise to a variable amount of faintly turbid exudate and small white flakes of leucocytes; the pleura contains an excess of clear fluid, which is often present also in the pericardium; the serous vessels are injected and small hemorrhages may occur, more especially in the subcutaneous tissues. The superficial lymphatic glands are swollen and congested or hemorrhagic; the spleen is enlarged, the kidneys and adrenal glands are congested; the lungs show a marked congestion and the intestines contain an excess of glutinous contents. Coverslips from the peritoneal and pleural exudates show bacilli, often in large numbers, and polymorphonuclear leucocytes. These cells frequently show engulfed bacilli. Cultures prove a general invasion of bacilli with relatively smaller numbers of organisms in the spleen and heart's blood.

**Guinea-pigs** react in much the same way as mice, larger doses being required to produce fatal results, while the bacilli show less tendency to invade the internal organs. Subcutaneous injections cause a local swelling consisting of pus-corpuses, serum, and blood; the superficial lymph-glands become swollen, and an exudate appears in the peritoneal and more rarely in the pleural cavities. Intraperitoneal inoculations give more characteristic results. Death took place in from 1 to 6 days depending upon the source and amount of the culture. The inguinal and axillary lymphatic glands are enlarged and reddened; the peritoneal cavity may contain glutinous fluid and floating whitish flakes of pus-corpuses, or with little fluid, there may be grayish-white solid exudates of considerable size over the liver, spleen, and intestines. The blood-vessels are injected, the small intestines are filled with a soft glutinous matter, ecchymoses occur in the mucosa of the intestines, and the Peyer's patches may be swollen and reddened. If death occurs late the swelling of the Peyer's patches may have disappeared and be represented by the "shaven-beard" appearance. The liver exhibits areas of congestive necrosis of considerable size; the adrenals and the kidneys are congested. The pleural cavity frequently contains an excess of clear fluid and the lungs are mottled. The pericardial vessels are also injected and the sac contains an increased quantity of clear fluid. The distribution of the

bacilli varies. With moderately virulent cultures they occur only in the local exudates in peritoneal and pleural cavities. In rare instances, indeed, they may disappear even from the abdominal cavity, be greatly reduced in numbers, absent from the internal organs and blood or occur there in very small numbers. This disappearance may have taken place when death has occurred as early as 24 hours after inoculation. Larger doses or intensified cultures give rise to a moderate invasion of the blood and organs. If the autopsy on these animals is delayed, especially in warm weather, an increase of bacilli in the blood rapidly takes place, so that erroneous results may be obtained. Within the local exudates the bacilli are surrounded by capsules and are often contained within polymorphonuclear leucocytes. The bacilli can also be cultivated from the fluid portions of the intestinal contents. The ingestion of cultures gives rise to no results unless the stomach-contents are first neutralized; in the latter case death may occur; the small intestine is hyperemic; the contents are hemorrhagic and mucoid and the bacilli can be cultivated from them.

The **rabbit** usually responds with a localized swelling at the site of the subcutaneous injection, from which the animal usually recovers. When the injection results fatally the local infiltration resembles that in the guinea-pig, being, however, more marked than in that animal.

**Cats** also succumb to subcutaneous injections. Feeding alone produces no result. If, however, croton oil be first administered and the culture be then introduced into the stomach, diarrhea sets in, the bacillus is recoverable from the dejections and death may result. In the last case the mucosa of the large intestine is hyperemic and secretes an excess of mucus. The **dog** may succumb to simple feeding of the cultures. In positive instances diarrhea sets in, the appetite is lost and death may take place in 5 or 6 days. The mucous membrane of the intestine is hyperemic; hemorrhages occur, and the cavity of the gut contains a great excess of mucus from which the bacillus may be recovered.

The dead cultures are also toxic. Certain results of the inoculations into guinea-pigs suggest that the fatal effects are due to a toxic agent rather than to an infection *per se*. Cultures killed by exposure to temperatures of 60° C. for from 15 to 20 minutes are still active. In the course of certain immunization experiments one of the goats of a series succumbed to inoculation with dead cultures. On November 22, 20 cc. of a bouillon culture, killed by heating to 60° C., were given under the skin of the shoulder. Considerable induration developed at the site of inoculation; diarrhea set in, from which the animal seemed to recover. On November 29, a second injection of 20 cc. of the culture was given; on the next morning the animal was dead. The *autopsy* showed edema over the site of inoculation. The nates were covered with thin, partly dried fecal matter. The mucous membrane of the gut was hyperemic and presented numerous punctiform hemorrhages.

Dead cultures injected into rabbits and guinea-pigs cause: (1) elevation of temperature; (2) symptoms of intoxication (especially in guinea-pigs) which may come on within two

or three hours after the injection; and (3) in rabbits, rapid recovery with a localized and decreasing swelling; in guinea-pigs, similar phenomena or death in a few hours or after 4 to 6 weeks. In the last instance the animals show great emaciation. In the case of those that have recovered from the immediate results of the injection agglutinating properties for the bacilli appear in the blood.

*Has this Bacillus been Found in other Epidemics of Dysentery?*—If the bacillus described is of significance in the etiology of dysentery it must occur with regularity in the disease. Whether or not it will be found to have the distribution that is necessary in order to establish this relationship, can only be determined from studies carried on in widely different places and in all forms of the disease. That the bacillus is identical with the organism obtained by Shiga in the epidemic of dysentery which prevailed in Japan, there can be no reasonable doubt. In morphological, cultural, and pathogenic characteristics the two organisms are indistinguishable.

Through the courtesy of Dr. J. H. Musser I have been enabled to study, bacteriologically and pathologically, a case of chronic dysentery contracted during the Spanish war in Porto Rico. The patient, a soldier, entered the hospital of the University of Pennsylvania in December, 1899. His dysentery dated back some months; the movements were frequently examined for amebæ with negative results. A brief abstract of the autopsy protocol is as follows:

The body is that of a greatly emaciated man about 35 years old. Dorsal decubitus. The peritoneal cavity contains a small amount of reddish fluid. The colon is thickened, and in the peritoneal surface, especially along the sigmoid flexure, shows dark points and lines of discoloration. The rectum and sigmoid flexure are contracted; the transverse colon, on the other hand, is dilated. The mucosa of the large gut is thickened throughout; in addition there are small, recent hemorrhages into its substance. There is no pronounced ulceration; the mucous membrane presents a granular aspect; there are superficial areas denuded of epithelium, and others, which are slate-colored and show dark pigmentation. The submucosa is not especially thickened except in the lower part of the gut, where there is much contraction. The mucous membrane of the transverse colon is edematous; the cecum is less affected than the colon, while the small intestine has entirely escaped. No pseudo-membrane is present except upon a small portion of the lower parts of the sigmoid flexure.

The bacteriological examination made from the contents of the hepatic and sigmoid flexures gave growths in which the two general types of bacilli already described were contained. The predominating form agreed with Type II (*B. coli communis* group); in addition, there were colonies of an organism which in morphological, cultural and pathogenic characters, and in the agglutination reaction, corresponded with the variety of bacilli represented by Type I. The histological appearances in this case differ from those in the acute disease and equally from those of the amebic variety. The changes are found more particularly in the mucosa and submucosa and represent, it would appear, a later stage in the course of the acute disease. Before describing the other changes it should

be mentioned that a striking feature in the case is the congestion in the mucosa, submucosa and muscularis. Numerous large veins, distended with blood, occupy the field of the microscope. Whether these vessels are newly formed cannot be stated positively; but they certainly are many times larger than any preexisting vessels normally met with in the same situations. In a few places the surface of the mucosa shows a necrosis of the hyaline or coagulative variety, there being no appearances of exudative fibrin in these areas. These necroses do not include the entire thickness of the mucous membrane, but cap superficial foci. There can be no doubt that this tissue-death indicates an exacerbation of the acute disease, with which, indeed, the great congestion may be partially associated.

The chief and, as I take it, characteristic changes in this stage of the disease are proliferative in character. The mucous membrane is not markedly altered in volume. Its structure is, however, greatly modified. Very few glandular crypts remain. The membrane is represented by a mass of spindle and epithelioid cells together with a reticular and coarser intercellular network, enclosing the remains of the crypts of Lieberkühn. The submucosa, also, shows a new growth of tissue, in which, however, appear much more advanced changes. The submucosa is composed of dense, almost hyaline, and structureless tissue, taking a vivid eosin stain and enclosing foci of epithelioid cells. The hardening and distortion of the gut were, doubtless, caused by this new growth of tissue and its subsequent contraction. The dilated blood-vessels, mentioned above, occupy a prominent place in this coat. A variable number of lymphoid, plasma, and eosinophilic cells occur, especially about the veins.

The muscular coat is also the seat of a multiplication of connective-tissue cells, which is shown by the masses of epithelioid cells separated by muscle-fibers, as well as an increase in foci of the fibrous tissue.

Blood-pigment is present both in the muscular and the subperitoneal coat.

The careful bacteriological studies in Egyptian dysentery, made by Kruse and Pasquale, contain numerous references to typhoid-like bacteria. Critical examination shows the majority to belong to the groups of *B. coli communis*. The typhoid characteristics depend merely on cultural resemblances—most marked in growths on agar-agar. Fermentation and their effects upon milk eliminate the suspicion that they may be typhoid bacilli, or the organism obtained by Shiga in Tokyo, or by myself in Manila. Still other examples of bacilli, similar to and possibly identical with *B. dysenteriae* (Shiga), have been found in dysentery, though they are not suspected of standing in any etiological relation to it. Pansini studied 4 cases of abscess of the liver, 3 of which followed dysentery. The bacilli, which were isolated, resembled *B. typhosus*—indeed, Pansini could not distinguish between the two series. Babes also, although only in a single instance, isolated such an organism from a case of dysentery.

Since the publications of Shiga's studies, Escherich and Celli have both attempted to show that the organisms obtained from their respective epidemics of dysentery are



identical with the *B. dysenteriae*. In both cases they have proceeded upon the false assumption that Shiga's microorganism was a variety of *B. coli communis*, whereas, in point of fact, it is much more nearly related in its cultural and physiological properties to *B. typhosus*.

The question naturally arises, In what ways does it differ from *B. typhosus*? Comparison of the Eberth-Gaffky and Shiga bacilli show the criteria of difference to be by no means numerous. The main features, however, are as follows: The latter shows less marked motility when first isolated and a tendency to lose motility rapidly in artificial cultivations; it displays a more uniform generation of indol; after a brief preliminary acid production in milk it gives rise to a gradually increasing alkalization; it is inactive to blood-serum from typhoid cases; but reacts with serum from dysenteric cases to which *B. typhosus* does not respond.

*The Agglutination Test.*—While the absolute value of this test in determining the specificity of bacteria may be open to doubt, its use in differentiation is now unquestioned. Undoubtedly there are limits to its usefulness, and experience (gained especially in typhoid fever) has shown that the changes upon which the property of the blood-serum depends for its evolution in certain instances may fail to take place. The tests in the case of the bacillus isolated in Manila were made at the time with blood obtained from acute and chronic cases of dysentery, occurring there and in the surrounding country. For carrying out the tests the blood was obtained in capillary tubes from the lobe of the ear of the living, and in larger quantities directly from the cavities of the heart by means of sterilized pipettes from the fatal cases of dysentery. The tests were made under the microscope and by growing the organisms in mixtures of bouillon and blood-serum. After our return to this country, the blood-serum from the case of Porto-Rican dysentery was employed and gave positive results. Through the courtesy of Assistant Surgeon Craig, stationed at the Presidio at San Francisco, I obtained capillary tubes filled with blood taken from convalescents and other soldiers suffering from chronic dysentery acquired in the Philippines. The present status of the agglutination reaction may be summed up as follows:

Positive results were obtained with cases definitely known to have been infected with the microorganism in question. The results obtained from the blood derived from chronic dysentery were more variable. Dr. Osler has written me of his experience. In several cases of amebic dysentery which have come under his charge in the Johns Hopkins Hospital, the blood-serum failed to produce the reaction with the bacillus obtained in Manila; in one case of the Porto-Rican disease a positive reaction was given.

The above results tend to emphasize the distinction of types of dysentery occurring in the tropics. They further tend to confirm the possibility that the acute dysenteries are caused by *B. dysenteriae*. To what extent the organism is concerned with the production of chronic dysentery remains to be established. That we must recognize a chronic form of tropical dysentery that is not in its entire course associated with the presence of amebæ in large numbers, and that possesses totally

different pathological lesions, is certain. I am inclined to the opinion that this type is not the commonest form of chronic tropical dysentery, and that it is less frequent than the amebic type. As it appears to be the form that gives a positive serum reaction with *B. dysenteriae*, its extent and distribution may now be open to investigation.

Bearing directly upon these considerations are the results of Lieutenant Strong's studies continued after our departure from Manila. He writes: "After you left we had a large number of acute cases of dysentery. It seems certain that this form, which we have begun to speak of as *acute infectious dysentery*, is independent of amebæ. I have now records of 14 cases (not all were fatal) which I studied bacteriologically. From the stools in all of these, there has been obtained a bacillus which agrees with the organism obtained by you. I have also obtained the organisms from the mesenteric glands in three fatal cases. In one case of acute dysentery with secondary acute fibrinous peritonitis I obtained it from the exudate. The agglutination reaction is not invariable. Amebæ were never demonstrable in any of these 14 cases. On the other hand, in every case with certain anatomical lesions we always find the amebæ. In some cases of dysentery in which the amebæ were absent and the bacilli present, that have lasted four to five weeks (one case lasted nearly two months) and then resulted fatally, we see a continuation of the same process that is observed in the acute fatal cases. The lesions are those of necroses of the mucous membrane and induration of the gut."

*Protective Inoculation and Serum Therapy.*—It is not unreasonable to hope that with the discovery of the specific cause of dysentery, particularly if it proves to be a bacterium capable of being artificially cultivated, means will be found by which protective inoculation may be carried out with effect and safety. The fundamental conditions underlying such immunization are now fairly established, and two general methods of accomplishing such results are open to investigation. In the first place, an active immunization may be achieved through the use of cultures of a determined grade of activity; in the second the serum of animals may be employed either as a therapeutic agent or to provide a passive immunity.

It has been found possible, through the use of cultures destroyed by heat or the addition of chemicals (mercuric), to protect small animals from subsequent inoculations with virulent bacilli. Larger animals, such as the goat, when treated first with the dead and afterwards with the living cultures, develop a gradually increasing resistance to the inoculations; their blood-serum assumes highly agglutinating qualities for the bacillus, and coincidentally acquires protective and healing properties. My own experiments relating to this topic have been carried out on small animals only. Shiga, has, however, been able to test the serum upon human cases. Dr. Eldridge<sup>2</sup> in his report gives the following figures: Up to November 1, 1899, Shiga had treated with the serums in 1898 in Laboratory Hospital, 65 cases, death-rate 9 per cent:

<sup>2</sup> Public Health Reports, Vol. XV, No. I.



in 1899 in Laboratory Hospital, 91 cases, death-rate 8 per cent; in 1899 in Hirowo Hospital, 110 cases, death-rate 12 per cent. During the same period of 1899 there were under ordinary treatment at Tokyo: at Honjo Hospital, 166 cases, death-rate 37.9 per cent; at Hirowo Hospital, 53 cases, death-rate 37.7 per cent; at Komogome Hospital, 398 cases, death-rate 34.6 per cent; in private houses, 1119 cases, death-rate 28.5 per cent.

I should, however, expect greater benefit from a species of vaccination, especially to those exposed to the endemic or endemo-epidemic dysentery of the tropics. The encouraging results of the injections of the dead bacilli of Asiatic cholera and typhoid fever render justifiable the use of a similar procedure in persons exposed to dysentery. The practical details of such inoculations will, of course, be established only after trials, preferably upon human beings who are anxious to submit to this method of treatment. I have found it possible to prepare cultures which after being killed possess a definite degree of toxicity for guinea-pigs. The only example of an experiment upon man yet available is that performed by Shiga, who directed that about  $\frac{1}{2}$  of an agar-culture, suspended in bouillon and killed by heat, should be injected into the subcutaneous tissues of his back. The immediate results of the injection were pain in the head, slight chill and fever, and local infiltration. After five or six days—the symptoms having in the interim entirely disappeared, except for some slight swelling—this area of infiltration increased and called for incision. The subcutaneous tissues were found thickened, indurated, and infiltrated with pus, which was sterile to cultures. The local lesion, similar to those in animals, was, it is thought, produced by the toxic substance contained within the dead bodies of the bacteria. Immediately after incision, all disagreeable symptoms subsided except the local infiltration, which disappeared gradually.

If this experiment can be taken as an index, the poison of B. dysenteriae is more active than the analogous substance contained in the bodies of the typhoid and Asiatic cholera

organisms. This objection, if true, could be eliminated by dosage, or, if necessary, by combining the vaccine with immune-serum, as has recently been recommended by the German Plague commission in carrying out the inoculations with the Plague bacilli. Shiga's blood-serum, 10 days after the injection, showed active agglutination of the bacilli.

An interesting, if somewhat disagreeable accident, was experienced by one of the laboratory assistants in Baltimore. In studying the acid production of the Manila bacillus a small quantity of fluid culture was aspirated into the mouth. The culture was expectorated and the mouth rinsed with a weak carbolic-acid solution. Notwithstanding this precaution a severe diarrhea, with bloody and mucous stools, pain and tenesmus developed within 48 hours. I was in Philadelphia at the time and the scientific ardor of the patient was so greatly depressed as a result of his discomfort and suffering that cultures were not made from the dejections, nor was I notified of the accident until several weeks afterwards.

Very little remains for me to say at this time. It is only natural to ask whether the foregoing considerations justify a belief in a specific organism of dysentery. My own sense is against that belief, although it must be conceded that the varieties of the disease are fewer than the clinical and pathological-anatomical conceptions of the time would lead one to suppose. Excluding the sporadic cases, which need a much closer bacteriological study than has been yet accorded to them, it is entirely possible that two specific organisms may be responsible for the epidemic and endemic diseases *per se*. I think that I have shown that tropical dysentery consists of a bacillary and an amebic form, separable in their early and their later stages by their clinical histories, their etiology and pathological anatomy. It is important to know whether the epidemic disease is more uniform in its causation and pathological anatomy. The studies of the Japanese disease by Shiga are highly suggestive of this interpretation, but additional observations will be required before we can accept as final his conclusions.

## A CONTRIBUTION TO THE STUDY OF THE ANATOMY AND PHYSIOLOGY OF THE PROSTATE GLAND, AND A FEW OBSERVATIONS ON THE PHENOMENON OF EJACULATION.

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It is not the purpose of this paper to go into the complete anatomy and physiology of the prostate gland; but to discuss some points, in relation to its finer histological structure, which have not hitherto been clearly elucidated.

*Review of the literature.*—In the literature many papers have appeared from time to time, but the ones that show exact investigation are strikingly sparse. In most of the various works on histological anatomy the descriptions are

short, superficial, and in not a few inaccurate. By Henle," Kölliker," Sappey," and L. Testut," much more detailed, and better accounts, are given.

Home," in 1806, announced the discovery of a third lobe, posteriorly, between the two lateral ones. For many years this view was accepted by all the English anatomists, but denied by the French. Later, Thompson," in 1857, made some careful examinations of a large number of cadavers; and

arrived at the conclusion that it is only occasionally present, and does not deserve the name of a third lobe. Recently, these observations have been confirmed by Griffiths.

Pettigrew,<sup>38</sup> Bell, Sabatier,<sup>39</sup> and Shaw<sup>40</sup> have described the gross structure and muscular arrangement, with varying degrees of exactness; but, unfortunately, their accounts by no means agree.

The embryology has been studied by Tournoux<sup>41</sup> and Mihailovicz;<sup>42</sup> and the evolution, in dog and man, by Regnaud.<sup>43</sup>

In Rüdinger's<sup>38</sup> monograph very good observations are given on the caput gallinaceum and prostatic glandular substance, but the stroma is rather superficially treated.

Stilling<sup>44</sup> has made a careful study of the cellular elements in rabbits and man, with reference to the origin of the concretions. He observed the organ, before and after coitus, and at different seasons of the year.

Langerhans<sup>35</sup> gave the best account, up to that time (1874), of the glandular tissue in man.

Svetlin<sup>45</sup> made a series of investigations, in order to establish definitely the exact number of ducts. He found after the examination of numerous adult glands that the number varied between fifteen and thirty-two.

The work of Griffiths is well known, and is probably the most practical that has been done on the gland. He has busied himself more especially with the changes that occur at different seasons, at different ages, and after various operations.

In the writings of Oudemans<sup>46</sup> and Disselhorst,<sup>47</sup> very good general descriptions of the gland are found; but the scope of the work was too broad to permit a minute histological investigation.

The opinions regarding the organ as a gland are very diverse. Thus Ellis<sup>3</sup> says its chief office is muscular, and he thinks the term "gland" should be abolished.

Handfield Jones<sup>38</sup> is of the opinion that it should be looked on as an aggregation of scattered tubules, rather than a gland proper.

Harrison<sup>17</sup> acknowledges the existence of the glandular substance, but holds practically the same view as Ellis.

Henle, Kölliker, and Sappey give prominence to its glandular nature; while Stöhr,<sup>48</sup> Orth,<sup>49</sup> and many others state that the organ is largely muscular.

Griffiths affirms that its chief function is glandular, and that it is entirely connected with the sexual organs.

*Material used.* The research was made on specimens obtained from man, the dog, cat, swine, mole, hedgehog, bull and hamster. Most of the work was done on the dog, as human material could not be obtained of sufficient freshness to permit of a study of the finer histology. Comparison has convinced me that no great difference exists between them. In man, the glands were examined in the adult, new-born and embryo; in the dog, in all stages of development; in the cat, full-grown and new-born; in swine, full-grown, castrated, and embryo; in the hedgehog, full-grown, half-grown, and embryo;

in the bull, mole and hamster only full-grown animals were utilized.

*Method and technique.*—The glands of the animals were taken immediately after death, and fixed in the following fluids: Zenker's, Herman's, Flemming's, van Gehuchten's; alcohol in various strengths; formalin 5% and 10%; sublimate 1%, 5% and concentrated; osmic acid, both by injection and maceration; diverse combinations of picric acid, formalin, and alcohol; acetic acid, sublimate, and picric acid; sublimate and osmic acid; chromic acid; and lastly a mixture of 3% pot. bichrom. and 5% acetic acid.

The best cell fixation was obtained by Flemming's solution, 5% sublimate, and the mixture of 3% pot. bichrom. and 5% acetic acid. This last named gave a very beautiful cell outline and protoplasmic preservation, which equaled, in every respect, Flemming's. The best preservation of the muscle was obtained by 5% sublimate, Zenker's fluid, and 5% to 7% formalin; and the best connective tissue in alcohol, 5% and concentrated sublimate, and a mixture of alcohol and sublimate.

The glands were all imbedded in paraffin, and cut in varying degrees of thinness; from 2 to 20 mm. For a study of the cells, 2 to 4; for connective tissue by the digestion method, 4 to 6; for elastic tissue, 12 to 20; for muscle, 18 to 20.

Transverse and longitudinal serial sections were made in the new-born child, in the half-grown, and new-born dog. Transverse, in the adult cat, full-grown, half-grown and embryo hedgehog, and embryo swine.

All the approved staining agents were tried, with varying degrees of success. The one found to give the clearest definition of nucleus and protoplasm was Heidenhain's iron-hæmatoxylin, alone, and counterstained with a 1% aqueous solution of rubin. In several instances a very beautiful nucleus was obtained by gentian violet, after osmium fixation; but no satisfactory result could be had with thionin.

For the muscle Van Gieson's picrofuchsin method was employed. Many consider this a very delusive and unsatisfactory stain, but I found quite the contrary to be true. Tissues fixed in Zenker's, alcohol, formalin, and sublimate, stain well; osmium preparations and specimens that have lain for a long time in chrome solutions take it poorly. After a method of Dr. Hoehl, I usually applied an aqueous solution, of 1% iod. kal. and 0.5% iodine, previous to staining. This is a very important addition, and enables one to get a good result, where the picrofuchsin would hardly tinge the section. The connective tissue showed with greatest distinctness in specimens fixed in a mixture of picric acid, formalin and alcohol. The staining will be discussed under the connective tissue.

The work was done in the laboratory of Prof. Dr. Spalteholz; for whose great kindness and efficient help let me here express my heartiest and most sincere thanks. Also to Professor His for materials given, and for the use of his microscopic sections. To Dr. Hoehl thanks are also due, for showing me the method of digestion, and for various points in staining.

# THE POSITION AND ARRANGEMENT OF THE MUSCULAR ELEMENTS.

On a superficial examination of the prostatic muscle, one sees a complicated network, of crossing and recrossing fibers, without apparent order or regularity; and it is only after a careful study of a number of serial sections, made from the gland in various stages of development, that a correct idea of their position and direction can be obtained. It must, therefore, be owing to this cause, that these various contradictory statements are found in the literature of this subject.

*Review of the literature.*—The internal sphincter of the bladder is spoken of by most anatomists as a thickening of the circular coat around the neck of that viscus. Others, Guthrie,<sup>35</sup> Taylor,<sup>36</sup> Bedford,<sup>37</sup> Hancock,<sup>38</sup> and lately Griffiths,<sup>39</sup> deny the existence of any such thickening, and assert that there is no real sphincter.

Pettigrew<sup>35</sup> recognized no directly circular fibers, and thought that they all ran in an oblique manner.

Into the caput gallinaceum, according to Morgagni<sup>40</sup> and Santorini,<sup>41</sup> were inserted muscular bundles, coming from the ureters. Chas. Bell<sup>42</sup> denied this, and claimed that they extended to the third lobe of the prostate. I shall attempt to show later on that both of these opinions are incorrect.

Ellis<sup>43</sup> regarded the prostate as essentially a muscular organ; consisting of circular and orbicular fibers, which are directly continuous with the bladder behind, and the urethra in front. According to him, it should be looked on as a specially developed portion of the circular muscle coat that envelops the urethra behind the bulb or spongy portion.

Hodgson<sup>44</sup> described the gland thus: "The muscular structure, from the mucous membrane of the urethra to the capsule of the prostate, may be considered as a general muscle coat of the urethra; interspersed with glandular tissue, and somewhat altered in form to adapt it to its new condition."

Sabatier<sup>45</sup> was of the opinion that the prostatic muscle is made up entirely of circular fibers, which are not connected with the bladder. He described two circular layers; one belonging to the urethra, and the other to the prostate; the fibers of one being arranged excentrically to those of the other.

Pettigrew<sup>35</sup> enumerated seven layers which were continuous with those of the bladder. He considered the verumontanum to be mainly a muscular body which had an important muscular connection with the urethral orifices.

R. Harrison<sup>46</sup> (1886) asserted that the prostate is a largely muscular organ, whose chief function is to support the bladder. Later, in 1889, he cited a number of cases to show that the gland acted as a sphincter for the bladder. In one case, he explained incontinence of urine as being caused by a want of development of this gland. In the last edition of his book, in 1895, he says he has had no reason to change his opinion.

Köl liker<sup>47</sup> states that the gland is surrounded by a thick muscular capsule, from which septa pass into the substance of the organ. He describes a circular muscle extending more or less around the gland, and a second longitudinal, situated

near the urethra. The arrangement about the single lobules is not given.

Griffiths<sup>39</sup> thinks that the prostatic muscle develops from the circular coat of the urethra, and is arranged in a circular manner about the lobules. It is only indirectly connected with the circular coat of the bladder.

Sappey,<sup>48</sup> Henle,<sup>49</sup> and L. Testut<sup>50</sup> say that the muscle is so disposed around the lobules, that they may be forcibly compressed.

In the majority of the books on histology there is no description given further than the assertion that the prostatic stroma is largely composed of muscle which extends from the muscular sheath surrounding the gland.

After having made a study of the gland in the before enumerated animals, I have arrived at conclusions which do not entirely agree with those previously set forth. In order to increase the clearness of the description, it is thought best to give the position and arrangement in the full-grown dog as seen in a series of transverse sections; beginning at the vesical neck, and going to the apex or urethral end.

First, there is met a bundle of thick muscle which is arranged principally in the circular direction; internally and externally to this is a thin longitudinal layer. As stated above, several anatomists deny the existence of this in man, but it was plainly to be seen in all the dogs examined. Hanging somewhat in relation, but not in immediate connection with the above sphincter, is a thick muscle whose fibers run longitudinally, circularly, and obliquely; the majority seem to take the last named course, and are disposed concentrically around the basal prostatic lobes. This muscle tapers, and becomes thinner towards the bladder; and in several instances there was a distinct fibrous septum between it and the vesical muscles. The bundles are smaller and much more compactly arranged than those of the bladder, and are on entirely different axes. The muscle encircles the entire urethra at this point; but the fibres are excentric to the urethral axis, thus being in strong contrast to the concentric circular coat. It is clear, therefore, that this muscle is not definitely connected with the urethra or bladder, but is associated entirely with the prostate. It is somewhat triangular in shape, and fills in the angle formed by the prostate and vesical neck. From it, projections are sent into and around the gland, in a complicated manner.

Anteriorly, a thick triangular-shaped projection lies in the middle, between the two halves; a second division, about one-half the size of the first, is placed outwards on the side of the gland. Posteriorly, it projects in a similar manner, connecting the two sides, and lying between the urethra and ejaculatory ducts; this is much thinner than the anterior portion.

The anterior division is pyramidal in shape, with the base on the surface, at which place it is 2 mm. in breadth; from base to apex 4 to 2 cm. It extends to near the middle of the gland, longitudinally, where it becomes very thin. The bundles of fibers run in various directions; the circular and oblique preponderate. It extends on both sides into the substance of the organ, on either side, penetrating between



and surrounding the lobules. The fibers diverge, passing from the side of one lobule to the opposite side of another, and so on, thus forming a figure-of-8 network around them. A dense thick sheath passes forward on the outside of the gland, and hugs the glandular substance very closely; this becomes gradually thinner, and disappears at the junction of the lateral and lower borders. On the surface of this sheath, there were seen numerous depressions which corresponded to spaces between the lobules; here the muscle undergoes very marked thickening, and gives off small septa which ramify in the substance of the gland.

As the middle is approached, the muscle becomes much thinner, more deeply situated, and the fibers assume a more longitudinal course. Now, to return to the posterior portion—vesical half—we find here the muscular bundles are not so compactly disposed, and their course can be more easily made out. In the center the fibers are distinctly circular, while immediately before and behind they are longitudinal. This mass lies between, and connects the hemispheres posteriorly; it extends on both sides into the substance and diverges around the lobules in the same way as in the anterior portion. Behind the above layer, and lying well out towards the periphery, there is a bundle of longitudinal fibers, which are entirely separate from the other layers; these increase in the urethral half, the bundles become larger and more aggregated, assuming a cord-like shape. As the end is approached, the two sides close in around this mass, and place it well up in the substance; still further on, the fibers assume an oblique course, and enter into the gland substance. In this region they become mixed with the longitudinal coat of the urethra, but are not a continuation of it, as is stated by many anatomists. The muscle is four or five times as thick as that of the urethra, and its fibers are arranged on a different axis. As we follow the sections we find, about the middle of the urethral half, a distinctly circular layer enclosing the urethra and several lobules of the gland. At this place there seemed to be a definite connection with the urethra, but in passing on they became entirely separate, and the urethral coat was seen to be distinct.

The urethral end, corresponding in man to the apex, is covered by a thick sheath of muscle, which lies in direct connection posteriorly with the above-described muscle, and slightly so with the anterior division. It extends deeply on the urethral surface, and on the upper surface is continuous with the sheath from the vesical end; on the lateral surface there is a break in continuity, which leaves a boat-shaped area over the base of one lobe, entirely uncovered with muscle. The gland is then, contrary to the generally accepted opinion, not completely surrounded by a sheath of muscle. From this layer, septa pass in between the lobules, and join those coming out from the vesical portion. I wish here to note especially the fact that the urethral end of the prostate stands well out from that canal, and that there is an entire separation of the smooth muscular elements.

On the upper and lateral surfaces, there is a thin longitudinal layer, which is continuous with the corresponding

coat from the bladder. The bundles are sparsely scattered in the vesicorectal fascia, and partly within the capsule; they become thinner and sparser, and finally disappear towards the urethra. It is stated by Pettigrew, Sabatier, and others, that this muscle is directly continuous with the outer urethral coat; but such was not found to be the case, in any instance. Underneath this, on the vesical half, there is occasionally present a thin circular layer; it is a continuation of the coat of the bladder and extends only a short distance out on the upper and lateral surfaces.

The septa, as before mentioned, are offsets from the posterior and anterior muscle masses and external sheath. They are thickest towards the periphery, and extend between the lobules as strong muscular partitions; in the interior, they divide, and become thinner and thinner; so that towards the urethra they disappear entirely. The course and disposition, as seen in the transverse sections, are so complicated that no definite order can be discerned; but by a study of the different axes a beautiful arrangement is to be made out. The fibers run in a circular and longitudinal manner; the circular are thickest and ramify among the lobules in a figure-of-8 course, thus enclosing each in a circular sheath, but not encircling them in the way described by Griffiths. Internal to this is an oblique or longitudinal layer, which lies immediately next to the gland substance, and encases the lobule more or less completely. The fibers commence near the apex, course along the side, bend over the base and run down the opposite side. This coat is probably in connection with the coats of the other lobules, but this point could not be definitely decided. This inner coat is interspersed between the finer divisions of the alveoli; the outer is seen only around the lobule. Luseney has described the longitudinal fibers in man, but makes no mention of the circular ones.

The individual fibers lie very near the cellular layer, being separated only by capillary blood-vessels and a basement membrane. In other areas a sheath of connective tissue is also interposed. The muscle-cells are long and well developed, with large oval nuclei situated near the center. In many places they could be seen directly inserted into connective tissue.

*Crossed striated muscle.*—This was present only in the portion of the urethral half; it is derived from that part of the sphincter urethræ externus, called the sphincter vesicæ externus, or sphincter of Henle. This muscle is made up of an outer thick layer of circular fibers, and an inner very thin sheath of longitudinal ones; these form a bridge between the two sides of the gland and penetrate among two or three lobules. In the periphery it forms a partition consisting of four or five fibers; deeper, only a few cells are seen scattered in the smooth muscle. In the cat the mixture was so intimate that it appeared as if one were inserted into the other. The longitudinal fibers extend more deeply, and can be followed to the center of the gland; they are interspersed from the surface to near the urethra, in the anterior fibromuscular septum between the hemispheres.

*Muscles of the prostatic urethra.*—First, on the vesical end:

the longitudinal external coat of bladder is continued over the prostate, as has been described. The circular ends at vesical neck. The internal longitudinal fibers, anteriorly, end in the connective tissue around the beginning urethra; posteriorly, they are inserted into the uvula vesicæ. On section, this body projects prominently into the commencement of the urethra, and very much resembles the form of the caput gallinaceum. This probably accounts for the belief held by Morgagni<sup>1</sup> and Santorini<sup>2</sup> that muscular fibers extend from the urethral orifices, and are inserted into the caput gallinaceum. From the border of the uvula vesicæ to near the middle of the gland, very little muscle is seen around the urethra; towards the center, the posterior and lateral walls, there are seen irregularly distributed muscular elements, largely mixed with connective tissue. The fibers are small and short and very irregularly disposed, and cannot be said to form a definite coat. They are present in the base of the verumontanum, but not in a greater degree than in the other urethral folds. In the outer portion it is somewhat removed from the urethral mucous membrane, and lies posteriorly; further on, the muscle is connected with the longitudinal coat of the urethra. In the anterior and posterior portions of the urethral half, situated near the surface, there are present a few scattered bundles of longitudinal fibers which can be traced back into the urethra. The circular layer of urethra becomes more or less incorporated with the prostate, but there is no definite connection. In many glands the cellular elements encroach so near the urethra that nothing remains of the wall, other than a thin submucous connective-tissue coat.

To condense the foregoing into a few words, it can be said: That the vesical end of the prostate is surrounded by a thick muscle composed of longitudinal, circular, and oblique fibers, from which a large process projects anteriorly and posteriorly between the two glandular hemispheres; and a thick sheath is sent out on either side, which encases the fore, lateral, and dorsal surfaces. The posterior process extends to the urethral end, where it spreads out around the external surface in that region. From these muscular divisions, septa pass into the gland, and surround the lobes in a circular and longitudinal manner, giving to each lobule two distinct coats.

The muscle coats of the urethra and bladder are inserted into the prostate, and not continued through it, and the urethral coats in the prostatic portion are replaced to a considerable degree by prostatic substance.

*Caput gallinaceum.*—This organ is spoken of by Pettigrew as being essentially muscular. That it contains muscle is true, but that its bulk is muscle is erroneous. Around the glandular portion there is placed a moderately thick layer of circular fibers which serve to expel the secretion. The other muscular elements seen therein are derived from the ejaculatory ducts, which retain their muscular coats to very near the mouths. In the lower portions the sheaths are quite distinct, while higher they become blended.

*New-born child and dog.*—The general shapes of the prostates in these are different, but their histological structure is

very similar. By a study of a series of sections, cut in the longitudinal direction, it is clearly to be seen that the longitudinal coat of the urethra diverges and runs in various directions between the lobules; while at the other end the circular coat of the bladder spreads out and ramifies in the gland, in a like manner, but in a different course.

These pass through the gland more or less at right angles to each other; the one circularly, the other longitudinally; thus giving every lobule two coats. In sections from the child, both could be easily observed; the inner being longitudinal and the outer circular. According to Griffiths<sup>3</sup> all the prostatic muscle is developed from the circular urethral coat; my examination has led me to a different conclusion.

In the hedgehog, mole and hamster, there is a separate circular coat for each lobule; and in the hedgehog a few longitudinal fibers are present. In the cat a similar disposition is present as in the dog. In swine the muscle of Wilson envelopes the whole gland.

It will be seen from the foregoing, that the prostatic muscle primarily develops from the muscular elements of bladder and urethra; but later it becomes entirely separate and exists as a definitely distinct muscle. It is composed of two sets of fibers, so disposed that each lobule may be individually compressed; and the gland as a whole, by the thick anterior and posterior layers. The whole muscular structure is arranged primarily, to compress the prostate, and not to act as a vesical sphincter, as has been supposed by many anatomists; notably by Harrison.<sup>4</sup> It is true that in the dog the gland must give the necessary constriction to the urethra, as the walls of the latter are very nearly replaced by it; but to say that it is a special sphincter is, I think, entirely erroneous.

First: On account of the anatomical reason given above.

Second: In the cat, and a number of other animals, the organ is situated at quite a distance from the bladder.

Third: In the hedgehog, mole, and animals of this class, it is above the urethra, and extends outwards and away from it.

Fourth: Horses and swine, which are commonly castrated in youth, do not suffer from incompetent bladders.

Fifth: In females the gland is absent, and no representative muscular structure is present; if its function were that of a sphincter, it would be found in them, even as in males.

Sixth: Men in whom there is want of development, or atrophy of the gland, do not suffer from incontinence of urine (Griffiths).

Seventh: If the muscle were connected in function with the bladder, it would not so completely atrophy after castration.

The strict prostatic nature of the muscle is also borne out by the evolution of the organ. I have noted in the very young glands that the lobules project out beyond the muscle, and the latter is later developed around them. This is also corroborated by Regnaud<sup>5</sup> and Mihálcovicz.<sup>6</sup> The latter writes: "Da die Prostata-drüsen früher zur Entwicklung kommen als die Musculatur, so scheint die mächtige Ent-



wicklung der letzteren eine secundäre Folgeder ersteren zu sein."

*Amount of muscular tissue.*—The muscular elements form in the dog about  $\frac{1}{2}$  of the substance; in man, about  $\frac{1}{4}$ . Notwithstanding these facts, the organ is spoken of by Orth, Stöhr,<sup>16</sup> and numerous others as being largely muscular. Thus Stöhr in his Histology says: "Die Prostata besteht zum kleineren Theile aus Drüsensubstanz, zum grösseren Theile aus glatten Muskelfasern." Ellis goes much further, and gives as his opinion that, as there is so little glandular substance, the propriety of calling the organ a gland is doubtful. These opinions are either the result of incomplete investigation or the examination of abnormal glands.

*Ejaculatory ducts.*—These retain their muscular walls to within close proximity of their openings on the crest of the caput gallinaceum. Henle<sup>17</sup> thought the muscle blended with that of the prostate; in some sections this appeared to be the case, but as the ducts were followed, it became evident that they were quite distinct. Finger speaks of a ring muscle around them, to act as a sphincter; this I did not observe; on the contrary, the walls got thinner as the mouth was approached.

#### POSITION AND ARRANGEMENT OF THE CONNECTIVE-TISSUE ELEMENTS.

The stroma is described in most articles on the prostate, as consisting largely of muscle; the connective tissue being supposed to play an unimportant rôle; and in the literature very little is said about it. Klein affirms that the stroma is essentially muscular; the connective tissue is present in very small amount and is situated in the capsule and finer glandular septa. Sappey, Henle, and L. Testut, all of whom give relatively lengthy descriptions, do not say anything exact in regard to it.

The glands of the adult, new-born, and embryo man and dog, in different stages of development, were examined.

This tissue was studied by the digestion method, and by staining with fuchsin, nigrosin, and Mallory's hæmatoxylin. Among the stains, the last named proved by far the best, and gave extremely clear and beautiful demonstrations of the finest fibers. My thanks are due to Dr. Caspari for specimens furnished.

The idea that the connective tissue is insignificant in amount is proved by the digestion method to be erroneous. It is shown to be relatively abundant, and will compare favorably with the reticulum of other secreting organs; it is amply sufficient to furnish the necessary support to the glandular structure, independent of the muscular tissue. The latter, no doubt, lends additional strength, but it is not placed in the gland for this purpose.

In the new-born and young animals, the connective tissue is in considerable quantity, forming about one-fourth of the organ, and is very rich in cells. As age advances, it becomes more fibrous, and is replaced to a certain extent by smooth muscle.

As found in the full-grown dog, it is arranged in the fol-

lowing way: On both the urethral and vesical ends there is situated, anteriorly and posteriorly, a thick wedge-shaped mass. Posteriorly, its shape is somewhat changed by the upward projection of the sulcus in this region. In the urethral half, similar, but slightly smaller, masses are seen. Toward the center of the prostate, longitudinally, the glandular substance very nearly approaches them, and the tissue becomes correspondingly thin. From these masses, thick, dense sheaths extend, and spread over the anterior, posterior, and lateral surfaces. Toward the median line, urethral and vesical ends, the gland is thick and contains a large proportion of muscle; while on the lower lateral surface it is thin, with no muscle. From this thick central portion, and from the anterior and posterior masses, broad and strong septa are sent into the substance and form partitions between the lobules; these in turn divide and ramify in the cellular tissue, forming a honey-comb network on which the cells rest. Into the alveolated spaces thus formed are yet finer projections which support a layer of cells and carry a capillary blood-vessel. Surrounding the urethra is a thick and dense mass, which cannot be differentiated from the stroma of that canal; from the lateral surface four to five similar septa, as was noted above, pass outward and join those coming from the exterior; these are broad near the urethra, and contain very little muscular tissue.

Lying immediately under the cells, and separating them from the capillary, is an extremely fine and delicate layer of apparently almost structureless tissue.

In these digested specimens, and those stained by Mallory's hæmatoxylin, it was very plainly visible. By the high power, it was seen to consist of extremely fine connective-tissue fibers. This forms the membrana propria, on which the cells directly rest; in several instances extremely fine elastic fibers were interspersed in it. The existence of a basement membrane has been denied by many; and others have held very diverse opinions in regard to it. Disselhorst affirms that the membrana propria, as seen with an oil immersion, consists of a structureless membrane. Regnaud, who has made a careful study of the gland in dogs, states that none is present. Stöhr affirms that it is very hard to demonstrate it in the human subject. Griffiths thinks it is composed of small epithelial cells. Stillinger also says it is made up of small round cells. Langenhans is of the opinion that it cannot be differentiated from the remaining connective tissue. On account of the poorly preserved condition of the human tissue, I have not been able to demonstrate its presence; but, as it is found in all the other animals, a doubt can scarcely be entertained as to its existence in the human subject.

Connective-tissue cells, mast and plasma cells, and leucocytes were scattered throughout the connective tissue, being most numerous in the larger septa in close proximity to the cellular layer. In the active stage they are present in greater numbers, and in younger animals they predominate.

Incorporated in the stroma is a large quantity of muscular tissue, and running through it are myriads of small blood-vessels and capillaries.

In old age the connective-tissue elements become much in-



creased, by their own hyperplasia, and by a degeneration of the muscle. In castrated animals the gland is almost entirely transformed into connective tissue.

#### DISTRIBUTION OF ELASTIC TISSUE.

The elastic tissue is spoken of by Romiti, Böhm and Davidoff,<sup>2</sup> Debierre,<sup>3</sup> Rauber, Henle, Quain, and others, as forming a part of the prostatic stroma, but no description is given. The only special work that I have found is by A. Antonini. He delineates a more or less concentric coat around the urethra, which he calls the fasci peri-ultrali; a thin crescentic layer under the mucous membrane of the verumontanum, the fasci otricoliari; and those in the gland, fasci glandulari. Although we both worked on the dog, I have not found exactly the same arrangement.

Transverse and longitudinal sections were made from the dog, at different ages; and in man, both adult and newborn. Three methods of staining were employed; namely: Unna's orcein; Weigert's iron fuchsin; and Spalteholz's elastic-tissue stain. The last named proved by far the best and brought out the fibers with a clearness that could not be obtained by the others. A modification of Weigert's was employed, which very greatly improved the stain. It is as follows: Stain in the usual way for 45 minutes; wash carefully with water, then thoroughly with 96% alcohol; stain for one minute with a concentrated solution of picric acid in 96% alcohol; wash out surplus picric acid with common alcohol, then with absolute alcohol; clear in xylol and mount in the usual way. This counterstain gives a yellow background to the black fibers, thus greatly adding to their clearness, and bringing into view the finer ones which were invisible. A trial will convince one of the value of this addition.

First, lying just under the mucous membrane of the urethra, and completely surrounding that canal, is a sheath of longitudinal fibers. These are thicker in this region than on the other portions of the urethra, but are directly continuous with the urethra in front and the bladder behind. The outer fibers diverge into the substance of the gland, and form a figure-of-8 network around the prostatic ducts. This serves to give each a distinct sphincter, and offers an effectual method by which it may be kept closed. Interspersed in this network are other fibers, which are circularly disposed; these are most numerous on either side, and posteriorly; in front, only a few are present. From these circular and longitudinal sheaths above mentioned, fibers radiate into the larger septa, where there they form a rich plexiform network; and in turn send finer fibers into the connective-tissue framework, between the cells. With the oil immersion these fine fibers are seen to be in relatively large numbers, and in some places to extend directly into the membrana propria. They are disposed for the most part in a circular direction around the alveoli.

The capsule is stated by most authors to be very rich in elastic tissue, but in the dog I have found quite the contrary to be true. In the muscle, a relatively large quantity is present, but in the capsule proper, it is sparsely scattered.

The anterior and posterior masses of connective tissue between the hemispheres is moderately rich in irregularly disposed fibers, which are in connection with those in the gland.

*Caput gallinaceum.*—In this organ there is a circular ring of fibers about the utricle, which extends downwards, and encircles the glandular substance more or less completely. Just underneath the mucous membrane, there is placed a crescentic layer of circular fibers; this is thinner than the former, and extends from base to apex. Encircling either ejaculatory duct is a denser circular sheath, which is partially blended with the above layers in the apex of the organ; but in the base it is entirely separate. In the base of the verumontanum, there is a projection upward of the longitudinal coat of the urethra; but not to a greater degree than on the lateral urethral folds. It appears, therefore, that in favorable sections the organ would present the appearance of containing a large quantity of the tissue, but in reality much of it belongs to the ejaculatory ducts and urethra.

In man the proportion in the organ itself is very much greater than in the dog; the coats above described are decidedly thicker and denser, and form over one-half of the entire stroma of the organ.

In the new-born baby there is a beautiful oval-shaped sheath surrounding the prostatic vesicle. Posteriorly, and at the sides of this, is a mass of longitudinal and circular fibers, which pass outward among the beginning ducts.

In castrated swine the elastic tissue almost entirely disappears. The same is most probably true of all animals.

*Ejaculatory ducts.*—These are encased in a dense coat which increases in thickness as the openings are approached; this is distinct and separate in its course through the prostate, from the elastic tissue belonging to that organ.

It should be remarked that, as the gland contains such a number of blood-vessels, some of the threads might have belonged to them. Care was taken in the examinations to exclude this error as far as possible.

In puppies the same arrangement was present as in the full-grown dog; the number, however, was much smaller, especially in the glandular portion.

In the adult man a similar disposition is seen to that in the dog; one difference is noted in the fact that the fibers in the glandular substance are more aggregated under the basement membrane, and probably a greater proportion lie in it.

In the membranous urethra the fibers are nearly all longitudinal; those at the neck of bladder are circular and oblique.

In the female urethra in this region, they are for the most part longitudinal.

#### PROSTATIC GLANDULAR SUBSTANCE.

The glandular elements, according to Mihálcovicz, are developed from the urogenital sinus; and the organ should be looked on as a highly organized urethral gland. This view I cannot accept; for it must be remembered that the Wolfian duct has its mouth immediately in this region; and it is therefore extremely difficult to differentiate the beginning ducts, whether they come from the one or the other. More-

over, the stroma, in part, originates from the genital cord, which surrounds the Wolffian duct; and the after-function proves beyond question, that it belongs to the generative, and not to the urinary organs. I think, therefore, it is most probable that the epithelium is an outgrowth of the Wolffian ducts; as are the testes, vas deferens and seminal vesicles.

The glandular substance is arranged in from 40 to 50 lobules, which are imbedded in a dense connective tissue, and surrounded by a beautifully placed muscular layer. It presents, in every sense, the character of a definite and compact gland, and is not, as asserted by Handfield Jones, "a number of scattered mucous tubules rather than a gland proper."

The lobules, as has been studied by Regnaud, and as I have observed them in the human embryo and new-born dog, project into the surrounding tissue as straight tubes. As the animal grows these give off branches from the sides, which divide again and again, until very complex lobules are formed. At first they are incorporated in muscle, but as they grow very much more rapidly than the latter, they pass beyond, and lie in the connective tissue. The muscle, later, extends itself and envelopes them. This is in striking contrast to the view held by Ellis, who affirms that "the glandular elements are only large urethral glands, which project among the urethral muscles." The tubules do not extend into the muscles, but, on the contrary, the muscles grow out into the gland.

The lobules are built on the alveolar type; are of a long conical shape, with the base toward the exterior, and the apex to the urethra; they measure across the base about 3 mm., and from base to apex one to one and a half cm. The base and sides are imbedded in connective tissue and muscle, as has been described. In the active stage, owing to a multiplication of their cellular elements, they are increased in size. From 5 to 7 lobules are placed in the longest longitudinal diameter, and 4 to 6 in the corresponding vertical; thus making from 25 to 30 lobules on either side.

The alveoli are relatively large, saccular in form, and have a diameter of 0.15 mm.; they permit a distention of twice or three times that size; toward the urethra they become smaller and less distensible. Five to seven are attached to a single duct; this empties into a larger, which in turn enters a still larger channel, until finally 3 to 5 main trunks are formed. These course toward the urethra, and unite, forming a common duct, about one to two mm. from the mucous membrane. In the posterior division of the gland the arrangement is different; there 4 to 6 lobules empty into the same duct, which penetrates the side of the verumontanum, and opens about 2 mm. behind the ejaculatory ducts.

The ducts, 30 to 40 in number in the dog, are about one mm. long and one-sixth mm. in diameter; they have no distinct coat of their own, but are surrounded by the dense connective tissue forming the urethral wall, and a special set of elastic fibers previously noted. They empty over the whole circumference of the prostatic urethra; the mouths are for the most part on a vertical plane with or behind the caput gallinaceum; only a few are situated in front. In man, the

openings are mostly confined to the urethral floor, and number, according to Svetlin, from 15 to 32.

I have observed by a careful study of a number of serial sections, and by sticking fine objects into the mouths of the ducts, that they all open in such manner as to eject their secretion directly towards the mouth of the ejaculatory ducts. In the dog those that empty in front are directed backwards. This I consider extremely significant, and, so far as I know, it has not been previously observed.

*Gland cells.*—These have been studied by Rudinger and Langerhans in man; by Stilling in the rabbit, and by Griffiths in the active and passive stages of the hedgehog and mole. My description will be confined to the dog; with some observations, as obtained from the cat and hedgehog. Human tissue was also examined, but the preservation was not such as to warrant a study of the glandular substance. I am convinced, by many observations on animals, that unless this gland is fixed immediately after death the cells undergo very rapid changes; I think, therefore, that descriptions that have been made on the human gland do not represent, even approximately, the true condition.

The cells were fixed, and stained as previously stated. In the deeper parts, the cells rest on a distinct membrana propria, and are disposed in a single row; they are of the long columnar type, and vary in shape as they are closely or loosely packed together. In the former condition they assume very diverse shapes; polyhedral, very long columnar, pear-shaped, and sometimes triangular. These various forms were given as different types of cells by Langerhans, but I am sure that they were produced by pressure from the neighboring ones. No cell membrane is present; the free border was usually clear and distinct, but in some instances it was uneven and ragged; this condition was occasionally so exaggerated that the cell contents were directly continuous with the secretion in the alveolus. This was noted with different fixing agents, and it is a question whether it was the result of the fixation, or a bursting of the cell with discharge of contents; the material on the outside appeared identical with the cellular protoplasm. The protoplasmic border next to the adjoining cell was quite plain in specimens stained by Heidenhain's iron-haematoxylin, while by eosin and erythrocin it was not clear.

The protoplasm was in large amount; in the outer half, it was densely studded with deeply staining granules, between which it was lighter, but no definite spongioplastic structure could be made out; (this appeared identical with the secretion in the lumen). The inner half contained fewer granules, and among them there was to be seen a number of very delicate threads forming the spongioplastic network. In the immediate neighborhood of the nucleus, it was much clearer; and in some to such an extent, that it gave the appearance of a vacuole. Behind the nucleus—that is, between it and the basement membrane—the protoplasm was extremely scant, and in the very active stage none was discernible. In the same region, other cells were seen, which had probably dis-

charged their secretion; the protoplasm was less, and not so granular.

The nucleus is about the size of a red blood-corpuscle; it is situated at the attached end of the cell, and seems in some instances to rest directly on the membrana propria; it is very distinct, sharply circumscribed, strongly staining, and has on the outer border a definite rim. The substance presents one large, and several smaller, intensely staining bodies; they have a ragged outline and lie in an extremely delicate network of chromatin threads. In the beginning of the active stage, and in younger animals, the chromatin elements are plainer, and in not a few, definite karyokinetic figures could be noted.

In other portions of the lobule, the cells are low cuboidal, the protoplasm is small in amount, and nearly clear; the nucleus is proportionately smaller, and is situated in the middle of the cell. They present all the characteristics of a less active, or an almost inactive, stage of secretion. Where the alveoli are much distended, the cells are very much flattened; and in the hedgehog they form a thin, membrane-like lining. Golgi's method was used to demonstrate the cellular ducts, but none were discovered. Various stains were employed to show mucous cells, but all were unsuccessful.

Passing down toward the urethra, the cells assume a cuboidal shape; the protoplasm is less clear and not so granular. The nucleus is smaller, denser, and more deeply stained, and is placed near the center of the cell.

In the ducts the cells are much more flattened, the protoplasm forms only a small rim and is entirely clear; it surrounds a small, homogeneous, deeply stained nucleus. The lowest portion of the duct is lined by an ingrowth of urethral cells.

The secretion in the alveoli stains very deeply with eosin and picric acid; it contains small structureless flaky bodies, but no concretion.

In the half-grown dog, three to five layers of cells are present in all parts of the lobule. The under rows are flatly cuboidal, irregularly placed, and do not form definite layers; their nuclei are relatively large, and surrounded by a narrow rim of homogeneous protoplasm. The over layer is made up of larger cells, rather more columnar-shaped, with a medium-sized, clearly defined nucleus; the protoplasm in the outer half shows a beginning granular appearance.

In the new-born child and dog many layers of cells are seen; in fact the whole lumen is nearly full. They are closely packed, flatly cuboidal in shape and have a very irregular outline. The protoplasm is extremely small in amount, and, in some, almost invisible; the nuclei are proportionately large, and appear as homogeneous deeply stained bodies.

In a hedgehog, which was examined in the height of the active season, the alveoli were thrown into numerous folds by cellular projections into the lumen. The individual cells were long columnar-shaped, with an irregular, not definitely circumscribed free border. The protoplasm and nucleus presented the same characteristics as those already described in the dog; the former was perhaps more granular and more deeply staining. I was unable to study the gland in the

winter season, and could not therefore observe the cells in the passive stage.

#### ADENOID TISSUE IN THE PROSTATE GLAND.

In the literature, no mention is made of the gland containing lymphoid tissue. In quite a number of prostates, bits of that tissue were scattered here and there throughout the substance. At first it was taken for round-cell infiltration, and not until toward the last of the work was its true nature determined. It is generally situated near the lateral surface. Two to three small nodes are usually together, with a rather thick layer of connective tissue between them. The nodes are surrounded by a thin sheath of fibers, which extend into the substance, and ramify among the peripheral cells; but do not penetrate far into the interior. In the specimens stained by Mallory, a very fine meshwork of extremely delicate fibers was discernible in the central parts. The cells are closely packed, and present the same appearance as lymphoid cells seen in other locations. Scattered in some of the nodes are minute channels, with extremely thin fibrous walls, and lined by endothelial cells; these are most probably lymph-vessels. Extending off into the prostatic substance are strands of connective-tissue, which form a kind of outside framework and support. The glandular prostatic tissue lies well up on the outside, being arranged as in other areas, and does not show any apparent connection with the lymph node.

Various methods were tried to inject the internal lymph spaces, but none proved satisfactory. With the superficial injections a few vessels near the periphery were filled—which did not look like blood-vessels—but were too few to give sufficient proof that they were lymph channels.

#### THE CAPUT GALLINACEUM.

This organ has been so well described by Henle and Rüdinger that it will be necessary to say only a few words in regard to it. Weber was the first to give an account of it; and in the works of many anatomists it bears his name; he thought it represented the uterus. Merkel, in 1848, promulgated the view that it had its homologue in the anterior portion of the vagina; which opinion has been accepted by Thiersch, Lilienfeld, Ratke, Mihálcovicz, and Tourneux.

The stroma, which consists of connective tissue, muscle and elastic tissue, has already been described. The glandular substance is situated near the apex; it is of an alveolated sacular form; has a moderately large lumen, and empties by a slit-like opening in the anterior portion of the crest. The cells are columnar shaped, arranged in a single row, and, in the active stage, show the same characteristics as the prostate, but to a less degree. The lumen is filled by a thin, slightly turbid alkaline secretion. After castration, as I have observed in the hog, the cells atrophy; and muscle and elastic fibers almost disappear.

It is asserted by many anatomists that this organ is functionless; but, considering the facts, that the glandular substance is made up of active epithelium, is surrounded by a thick muscle which serves to expel its secretion, and that



atrophy occurs after castration, I think it undoubtedly true that it furnishes a secretion which is necessary for the semen. The function of the hill will be fully discussed when speaking of ejaculation.

From the foregoing paper the following conclusions may be drawn:

First. The prostatic muscle is derived from the longitudinal coat of the urethra, and the circular layer of the bladder.

Second. Every lobule is surrounded by a circular and longitudinal coat, so arranged as to expel quickly and forcibly the secretion.

Third. The prostatic muscle of the full-grown animal is independent of both urethra and bladder, and is only indirectly in connection with either.

Fourth. The muscle is not so disposed as to compress the urethra, or to act as a sphincter to the bladder.

Fifth. The connective tissue is found in nearly the same amount as in other secreting organs; and is amply sufficient to give all the needed support to the gland, independent of the muscular elements.

Sixth. A *membrana propria* is present in all cases, and consists of very fine connective-tissue fibers. There is a sheath of longitudinal elastic fibers around the prostatic urethra, from which the outer fibers diverge around the prostatic ducts in a figure-of-8 manner, and thence onward into the glandular substance.

Seventh. Outside of the above named elastic coat is an incomplete circular set of similar fibers, which also pass into the glandular substance.

Eighth. In the gland substance a rich elastic mesh-work is seen lying under the cells, with a few extremely fine fibers in the *membrana propria*.

Ninth. The glandular substance forms about five-sixths of the organ.

Tenth. The cells are disposed in one layer; tall columnar shaped; have a large amount of protoplasm, and a well-defined nucleus. In the same lobule areas are present where the cells are entirely inactive.

Eleventh. Adenoid tissue is scattered at irregular intervals throughout the gland.

#### THE FUNCTION OF THE PROSTATE.

The opinions of physiologists respecting the function of the prostatic gland have been very diverse and contradictory; some have gone so far as to assert that it has not sufficient glandular function to warrant the use of the term gland. Others claim, that as a gland, it fills a *very* important office.

Wagner was of the opinion that in some of the lower animals, it, in connection with the *vesiculae seminales*, secreted a fluid, which was ejected into the vagina after the semen, and prevented the former from running out.

Ellis thought its main function was muscular, being that of expelling the semen into the forepart of the urethra; and that its glandular nature was very insignificant.

Harrison affirms that its chief rôle is to act as a support, and a sphincter to the bladder.

Handfield Jones asserted that "it should not be looked at as a gland proper, and that its part in generative function was not to add any essential element to the fecundating fluid, but merely to appropriate a viscid material involved, in which spermatozoa may be securely transported on their destined route."

Chapman states that the function is not known. Herman, Hensen, and others are of the opinion that the gland, in connection with other accessory glands, serves to give the motility to the spermatozoa.

Steinach, in a very careful and painstaking work, found that after extirpation of the seminal vesicles in rats, their fecundating property was very much decreased; and that with extirpation of both seminal vesicles and prostate, it was brought to nil.

Fürbringer gives a very interesting account of a patient suffering from spermatorrhea; the semen passed without sexual excitation contained nearly immotile organisms; while in that ejaculated during the sexual act, they were very lively and active. He thinks the change was due to a mixture of prostatic fluid; and concludes that the function of the organ is to give a secretion, that stimulates the movement of the animalcules.

In order to elucidate the subject more clearly, it will be necessary to say something respecting the motility of the spermatozoa. It is stated by nearly all anatomists that in the testis, the organisms are immotile or nearly so. Hammar found that in the epididymis, nearest the testicle where the semen was thick, there was no motion; but toward the beginning vas, owing to glandular secretion, the fluid became thinner, and a part of them were somewhat motile.

In the ejaculated semen, they are all motile; it appears, therefore, without doubt, that they must meet some substance on their outgoing, that influences their motility. In order to determine this, various experimentation has been done. Thus Kölliker found that they moved freely in lymph, blood-serum, weak alkaline solutions, &c.; while they were brought to a standstill by gums, dextrin, mineral salts, weak mineral acids, &c.

Herman and Gruenhagen affirm that the movement is lively in the secretion of the accessory sexual glands.

Steinach observed lively motion, in a mixture of normal salt solution, with semen taken directly from the testicle; but it came to a standstill in three hours. A second mixture was made with prostatic secretion; in this there was seen a very lively motility, which continued for twenty-one hours.

In order to throw still more light on this subject, a series of experiments was instituted, the results of which will be given in the following:

The dogs were killed by a blow on the head; the testes and prostate were removed and laid in a warm, moist oven. The microscopic examination was made on a Ranvier warm-stage, which ranged between 37 and 38° Cels.; and every care was taken to make the work as nearly faultless as possible.

The semen was first examined alone, from the testicular

substance, globus major, globus minor, and vas deferens; secondly, with a mixture of prostatic juice; and thirdly, with normal salt solution.

We found: First. In the testicle itself there was no movement.

Second. In the globus major, no motility.

Third. In the globus minor slight movement of a few organisms, where the fluid was thin.

Fourth. In the vas deferens, slight motion in the portion where the liquid was thin; in the thick parts, which composed the largest bulk, there was no movement.

Fifth. In a mixture of prostatic juice and semen from the substance of the testicle, there was distinct, but not lively, motion.

Sixth. Semen out of the epididymis with prostate juice showed lively motility, which continued unabated for some time.

Seventh. Semen from the epididymis with normal salt solution gave lively movement, in the places where a mixture had occurred. In other areas where the liquid was thick, no motility was apparent. The same was also true of the prostatic mixture.

We explain the production of the immediate movement by a thinning of the fluid, and not by a distinct stimulating influence of the prostatic juice. The latter may also exist, but, from the following observations, we think the thinning is sufficient:

First. In the testicle and globus major the fluid was very thick, and no movement was seen.

Second. In the globus minor and vas def. a part of the fluid was thinned from the secretion of the epididymis; in this part alone was movement noted.

Third. After mixture with the prostatic juice motility was seen only where the semen was thin.

Fourth. After the addition of the salt solution the same was seen as with the prostatic secretion.

For the continued motility more is necessary than the mere thinning; for in the salt solution, all movement ceases after three hours; whereas, in the prostatic juice, it continues over 20 hours. (Steinach.)

From the above the following conclusions may safely be drawn:

First. That the immediate production of motility of the organisms is induced by a thinning of the testicular secretion with the prostatic juice.

Second. The continued movement is probably kept up by substances in the prostatic fluid, that either act as stimulants or as food for the organisms.

Third. Unless a homogeneous mixture is made, thick portions remain, where there is no movement.

Fourth. We take it, therefore, that, as the dog has no seminal vesicles, and the gland of Cowper is very insignificant, the function of furnishing a fluid, in which the spermatozoa can freely move, belongs entirely to the prostate gland. It then becomes apparent that the organ is almost as important as the organisms themselves.

## EJACULATION.

The view was first promulgated by Weber, and has been accepted by nearly all anatomists since, that the *caput gallinaceum* became intensely congested during coitus, and prevented the back flow of semen into the bladder. In a perusal of the literature I have not found this contradicted. But in the course of my work on the prostate gland, I have become convinced that the idea is erroneous; the grounds for which are set forth in the following:

First. The verumontanum is not situated in the posterior portion of the prostatic urethra, but in the middle and anterior portions; so that, if the swelling was sufficient to block the urethra, it would obliterate the whole cavity.

Second. The caput gallinaceum is in the most capacious part of the prostatic urethra. It is not probable that an organ which was to act as an obstruction would be placed in a position which was most unfavorable for the performance of that function.

Third. The urethral fold covering the organ is as vascular as the others; but the substance of the organ proper is much less so; and in several cases, pointed out by Rüdinger, it was very deficient in blood-vessels. It is, therefore, not vascular enough to produce the necessary swelling to strongly obliterate the urethra at this point.

Fourth. From the crest it gradually slopes toward the membranous urethra, forming the crista urethralis anterior, and does not end more or less abruptly, as would be expected if it were intended to act as a valve. It is thus in a very poor mechanical condition to offer resistance, even if it were forcibly pressed against the anterior wall.

Fifth. The ejaculatory ducts empty on, or very near, the crest of the elevation; most of the prostatic ducts pour out their secretion opposite or behind it, so that if it were sufficiently enlarged to obliterate the urethra, it would entirely close both prostatic and ejaculatory ducts.

Sixth. The corpora spongiosa, in the anterior portion of the urethra, offer the same kind of resistance; and to nearly, if not altogether, the same degree as the verumontanum. The congestion is even greater in the penile portions, for the venous return is prevented by muscular contraction.

Seventh. In the hedgehog and cat the organ is placed considerably forward in the urethra; and between it and the bladder the urethra is narrow, and surrounded by a thick muscular coat, which offers all the necessary resistance.

Eighth. A cast taken of the distended urethra shows the organ pushed into the anterior portion and it is, relatively, a very insignificant elevation.

Ninth. An artificial erection was made by forcibly filling the blood-vessels of penis, prostate, and bladder. During this, a low melting paraffin was injected into the urethra; under very slight pressure it passed directly into the bladder. After the bladder was quite full, the pelvis was cooled, and laid in strong muriatic acid, until the flesh was removed. The cast thus obtained showed a moderately capacious prostatic urethra, with the verumontanum extending not more than half way to the anterior wall.

Tenth. During the highest point of an erection, micturition can be accomplished, although not with the same force as otherwise, but this fact proves conclusively that the urethra is not occluded. This point has been noted in the insane and I have personally observed it in other cases.

Eleventh. It may be argued that the prostatic muscle contracts, narrowing the urethra, and thus aiding in the occlusion of the canal. This cannot occur to a material degree, for the muscular arrangement is not such as to permit it.

The above is, I hope, sufficient to throw some doubt on a generally accepted theory, which I am convinced is erroneous.

Next will be considered the mixing of the semen and prostatic fluids, and the ejaculation of the same.

It has been shown, in what has been said of the prostatic function, that in the testes and epididymis, the vast majority of the spermatozoa were motionless, and that by a mixture of the semen with prostatic secretion they became distinctly motile.

It appears, therefore, absolutely essential for a mixture of the two fluids to occur; otherwise the organisms remain unable to move, and consequently not capable of producing fecundation. It was also noted that unless the mixture is perfectly homogeneous, large numbers of the organisms remain in thick portions of the fluid. As the semen is a thick, tenacious fluid, more or less mechanical means are necessary to produce a proper incorporation.

It can, therefore, be asserted that, first, a mixture of the two fluids must be brought about; and, second, that the union must be homogeneous.

We will now return to the anatomical arrangement, and see how this occurs.

The ejaculatory ducts always empty on the crest of the caput gallinaceum and the prostate by from 30 to 40 openings in the wall of the urethra. These facts have been noted by all anatomists, but no significance has been given to them. This arrangement, I shall attempt to show, is of the very highest importance.

The prostatic ducts, as I have seen by study of serial sections, and by sticking fine objects into the mouths of the ducts, all converge toward the caput gallinaceum, and are directed so as to eject their secretion toward the openings of the ejaculatory ducts. The two largest are situated just behind the mouths of the ejaculatory ducts, and throw their secretion in the same direction as the others. Thus, as the semen is being poured out, 30 to 40 streams of prostatic fluid are ejected into it. It now becomes apparent why the ejaculatory ducts open on this eminence; namely, to be in a position so that the ducts from the floor, sides, and roof, posterior and anterior, can reach it. We have in this way a most beautiful anatomical arrangement for forming a perfectly complete mixture of the two fluids.

I think, therefore, that the main function of the prominent eminence of the verumontanum is to afford a hill on which the ejaculatory ducts can empty.

If we revert to the muscle, we see that every lobule is sur-

rounded by a relatively strong muscle; so disposed as to expel the lobular contents quickly and forcibly.

Thus, without physiological proof, we have an anatomical arrangement which proves the fact that it is necessary for a thorough mixture to be made.

It is now left to consider the expulsion of the fluid; before doing this it is necessary to glance at the muscular arrangements; namely, the sphincter of Henle, and the sphincter membranaceæ urethræ. The last named commences, we will say for convenience, at the outer portion of the urethral half of the prostate, and extends along the urethra, encircling the membranous and part of the bulbous divisions, and ends about the middle of the anterior half of penis. In man and dog, it is from 0.3 to 0.8 cm. in thickness; at the beginning it forms a bridge between the two sides of the gland, and is inserted into the connective tissue between the lobes. Immediately ventralwards it is thickened, and forms the so-called sphincter of Henle; which was supposed by him to act as sphincter to the bladder. This idea has been accepted by most anatomists, while others, notable among whom are Sappey, L. Testut, and Griffiths, have disputed it. The chief office of the remaining portion of the muscle is thought by quite a number of authors to be that of keeping the bulbous urethra closed, and accelerating the flow of urine. Henle, Frank-Martin, Hunter, Sappey, L. Testut, and Griffiths, were of the opinion that it was mainly connected with seminal organs, and aided largely in the expulsion of the semen.

First, in regard to the external sphincter of Henle, I am of the decided opinion that it does not act as a sphincter to the bladder; the grounds for which belief are set forth in the following:

First. The bladder is provided with a circular sphincter at its neck, which is amply sufficient to hold the urine.

Second. In the female no such muscle exists. If it were necessary as a sphincter, it would certainly be more needed by women, where the urethra is much shorter, and the bladder is dragged about by the uterus.

Third. As the prostate gland is between it and the bladder, urine would be permitted to enter the prostatic urethra, and would be stopped over the orifices of the prostatic and ejaculatory ducts.

Fourth. In the cat and some other animals, as first pointed out in this connection by Griffiths, it is removed quite a distance from the bladder, and could not act as a sphincter.

Fifth. In serial sections of the prostate and membranous urethra I found in every instance that the portion of the canal which was surrounded by that muscle was wide open, while the neck of bladder was closed.

The remaining portion of the muscle is no doubt concerned in the phenomenon of micturition, but that its chief work lies in that direction is very questionable. It was first pointed out by John Hunter that in castrated animals, this muscle becomes white, fibrous, and nearly functionless. Later, Griffiths confirmed these observations, and extended the research to other animals, which had a distinct rutting period.

In the castrated animals he found the muscle tough,



fibrous, and ligamentous; in the quiescent stage of the others, it was atrophied, contained a large amount of fibrous tissue, and had lost very largely its cross striation. I have observed the muscle in castrated hogs, and found it atrophied to a certain extent, but not to such a degree as seen by others.

Now, to return to the ejaculation; the semen is ejected forcibly into the urethra in the direction of the membranous (urethral) part. It does not pass backward into the bladder; first, because the manner by which it is ejected gives it a forward impulse; second, the neck of that viscus is closed by its own sphincter; and, third, the anterior part of the urethra dilates, and draws the fluid forward.

As the semen is being poured out, the longitudinal fibers of the sphincter urethræ contract and dilate the caudal half of the membranous, and a portion of the bulbous, urethra; this produces a large cavity, and the semen rushes in to fill it. When this is accomplished, the contraction extends to the end inserted into the prostate and draws the lobes together, thus compressing the prostatic urethra, and closing the orifices of the prostatic and ejaculatory ducts. The wave proceeds to the thick portion of muscle, immediately in front of the gland, and closes the urethra at this point; it will be remembered that here is the narrowest part of the canal, so that in this region a pressure that would hardly close the bulbous division, will strongly obliterate the whole canal; we see also that the muscle is thickened in this place. Here we have the sphincter that closes the urethra and prevents the semen from going back into the bladder. Therefore the so-called sphincter of Henle, which is in reality only a part of the sphincter membranaceæ urethræ, is not a sphincter to prevent the urine from going out of the bladder, but one to hinder the semen from going into it. The semen is now expelled from the urethra by the continuing contraction of the anterior part of the muscle, together with the bulbocavernosus, ischiobulbosus, and a part of the constrictor redi penis.

During later stages of the ejaculation, the prostatic and ejaculatory ducts remain closed, in the manner previously described. The muscular contraction in the vas deferens, seminal vesicles and prostate is probably kept up, thus putting the contents of the respective organs on extreme tension; so that at the moment of relaxation, the fluid rushes out and furnishes material for the second part of the ejaculation.

The above, on first sight, appears to be a long process composed of several stages, but this, in fact, is not the case. The semen runs into the anterior portion, directly after it enters the canal; the muscle then contracts, closing off the bladder, and expels it from the urethra.

It is impossible to subject this to experimental proof; and it is simply put forth as a probable theory, in the light of the anatomical arrangements.

NOTE.—I was not able to observe the gland in the quiescent stage; but examined it in castrated hogs, and found a moderately thick muscle which, macroscopically, did not appear fibrous; and on microscopic section the fibers were well developed and presented a distinct cross striation.

Although the muscle is chiefly connected with the sexual function, it is not to be expected that it will lose entirely its

The conclusions that may be drawn from the above are the following:

First. The verumontanum does not prevent the entrance of semen into the bladder.

Second. The semen is prevented from passing backward into the bladder, by the contraction of the so-called sphincter of Henle.

Third. The prostatic ducts are so arranged that they eject their fluid directly into the outpouring testicular secretion, thus producing a homogeneous mixture.

Fourth. The longitudinal fibers of the sphincter membranaceæ urethræ dilate the outer half of the membranous, and a portion of the bulbous, urethra; and by this means draw the semen from the prostatic portion.

Fifth. During the last act of ejaculation, the orifices of prostatic and ejaculatory ducts are closed, and their respective fluids put on much tension; so that at the moment of relaxation, a sufficient quantity of semen is poured in for the next emission.

Sixth. The sphincter membranaceæ urethræ aids, not only in carrying the semen along the urethra, but helps very materially in expelling it.

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histological structure after castration, for the part it plays in micturition requires it to be active.

It is difficult to understand how a muscle, which, according to Griffiths, was "tough, fibrous, ligamentous, and had lost nearly all its cross striation," could be strong enough to act in obedience to the will, and check the flow of urine, during micturition. Such a function, he acknowledges, it possesses.

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## A PIN IMBEDDED IN THE RECTUM.

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Foreign bodies are not uncommonly found located in different portions of the alimentary canal, and such small objects as pins, tacks or fish-bones, which are easily swallowed, and which from their size and shape pass easily through the ileocaecal valve, are not infrequently removed from the rectum. The following case of foreign body is of interest, not so much from its rarity then, but because of the peculiar way in which the pin was imbedded in the rectal wall.

The patient, E. W., widowed, age 55, came to me on Dec. 2, 1899, complaining of a feeling of pressure in the rectum, of general malaise, and of having passed blood with the stool on several occasions. On careful questioning the patient stated that she had been troubled with some vague abdominal discomfort for about 5 years, though she did not attach any importance to her symptoms, as they were but slight. I do not believe they had any connection with the passage of the foreign body through the intestinal canal. Two weeks before coming to me she was suddenly seized with sharp pain in the rectum, and constant rectal tenesmus. This pain was stabbing in character, most severe when she exercised, or when the bowels were moved, but always present as a dull ache even when she remained perfectly quiet. She had seen traces of blood in the stools on several occasions, and had suffered one slight hemorrhage from the bowel.

Examination revealed normal external and internal genital organs. On introducing the finger into the rectum a wire-like body was immediately felt, projecting across its lumen, about  $1\frac{1}{2}$  cm. within the anus. This, on more careful examination, proved to be a pin with its head buried to the depth of 5 mm. in the lateral wall of the gut, the point being free and impinging against the opposite wall. The rectal mucosa in this area was somewhat thickened from the constant irritation of the sharp point, and a free sanguino-purulent discharge covered the finger when it was withdrawn from the bowel. Slight induration of the rectal wall around the point of penetration of the pinhead was felt, but no signs of abscess formation could be made out.

The pin was easily removed by introducing a pair of forceps into the rectum guided by the finger, seizing the point to prevent its wounding the mucosa, and dragging the head from its bed in the rectal wall. The whole operation required but

a few moments for its completion, and caused but little pain. It was not necessary either to use an anesthetic or to dilate the sphincter, as the foreign body was so close to the anus, and though some little pain was caused by the manipulation, it was not by any means unbearable.

The after-treatment consisted in frequent irrigations of the rectum with warm normal salt solution, and regulation of the bowel movements. This treatment gave complete relief to all the symptoms, and an examination two weeks later revealed a normal condition of the tissues.

A case of this kind is interesting chiefly from the difficulty in determining how the pin could have reached this position, and afterward have become imbedded in such a way in the rectal wall.

Four methods may be imagined by which foreign bodies can enter the rectum. First, they may be swallowed and traverse the intestinal tract to the rectum; second, they may be introduced into the rectum through the anus; third, they may enter the rectum by ulceration through its wall, from surrounding tissues or organs; and fourth, they may be formed in the intestine (enteroliths).

In my case the third avenue of entrance can almost certainly be thrown out of consideration, as the patient was perfectly certain that she had never stuck a pin into herself; and if a pin had penetrated any portion of the body deeply enough to remain imbedded in the tissues, she would certainly have been cognizant of this fact.

This leaves but two methods by which the pin might have reached the rectum, and it is more probable that she swallowed it, rather than introduced it through the anus.

That it is not an infrequent occurrence for pins to reach the intestinal tract in this way is shown in an article by J. F. Mitchell, appearing in the Johns Hopkins Bulletin of Jan.-Feb.-March, 1899, entitled "The Presence of Foreign Bodies in the Vermiform Appendix, with especial reference to Pointed Bodies," in which he describes a number of cases of pins and other like bodies in the appendix. Since the appearance of this article, several like cases have been reported, and in all of them the pin was evidently swallowed, as it would be impossible for it to reach the appendix in any other way.



The same fact is proved by the number of other foreign bodies found in the rectum—fish-bones for instance, which are certainly swallowed. Goodsall ("Notes on 20 Cases of Foreign Bodies in the Rectum," *St. Bartholomew's Hospital Reports*, Vol. XXIII, 1887, p. 71) reports twenty cases which he saw personally; in this number a fish or other bone was present nineteen times; a pin, once.

It is easy to conceive how a pin might be swallowed when the habit so frequently indulged in by women, of holding pins in the mouth while fitting a dress, is considered, and the ease with which it slips down is evidenced by numerous examples of the so-called "human ostriches," exhibiting in circus and vaudeville performances, who swallow with apparent ease nails, hairpins, chains, glass and other comparatively large bodies. A pin might also fall from the dress into the food and be swallowed without consciousness of the fact, and this is probably the way in which my patient became possessed of her foreign body.

From a consideration of the general character of foreign bodies removed from the rectum, with the history of how they reached this organ, we may conclude that the bodies introduced into the rectum through the anus are commonly of large caliber, and usually not sharp, while those entering the rectum from above are apt to be small and elongate in shape. This rule points in my case to the entrance through the mouth, rather than to its introduction through the anus.

How the head of the pin became imbedded in the bowel wall while the point remained free is a more difficult question to answer. It seems probable that, as the pin was forced down by the peristaltic movement of the bowel, imbedded in fecal matter, the head in some manner became engaged in one of the rectal pouches. We might suppose, then, that the pin would lie against the rectal wall, the head downward and the shaft extending upward parallel with the intestinal lumen. Sooner or later ulceration would occur, and the head become buried in the mucous membrane; after this had occurred the passage of a hard fecal mass, or a violent peristaltic contraction, would force the point downward across the lumen of the bowel, when the acute symptoms would begin.

That the point of the pin, instead of the head, did not become imbedded in the rectal wall seems to be only a matter of chance; if this had occurred, it is reasonable to suppose it would have penetrated the tissues more deeply, and a perirectal abscess would have resulted. Goodsall (*l. c.*) speaks of a case in which an abscess formed around the pin, giving rise to a blind internal fistula. In this case the head of the pin had penetrated the rectal wall, as on operation the pin was found projecting into the rectal lumen through the opening of the fistula.

It is not difficult to conceive why, after passing through the whole intestinal canal safely, probably imbedded in a mass of fecal material, it should have caught so close to the anus, as it can be explained by the narrowness of the anal opening, when compared to the rest of the intestine. Goodsall concludes from the study of his twenty cases "that the site of the puncture is within the last inch or three-quarters of an inch of the rectum." This situation may be explained

in all of the cases by a transverse position of the foreign body and the comparative narrowness of the anal opening.

The length of time required by such a body to traverse the intestinal canal cannot be determined from the history given by my patient. Goodsall, from studying the previous histories of his cases, states that the time varies between one and nine days, and from the comparatively clean appearance of the pin in my case, probably about the same amount of time was required.

The immediate treatment was perfectly simple, consisting in the introduction of a pair of forceps guided on the fingers, and the localization and extraction of the pin without previous dilatation of the sphincter ani, or the use of an anesthetic. Goodsall found it necessary to have recourse to a general anesthetic in quite a number of his cases, though it is to be noted that more than half of them were suffering either with an abscess or fistula when they came under his care.

The after-treatment consisted of frequent irrigation of the rectum with normal salt solution, which gave immediate and complete relief to all the symptoms. In case this had not given the wished-for results, mild antiseptic irrigations, consisting of thin starch-water, containing boracic acid, extract of hamamelis, or other mild antiseptic, would have been used, as we have found all of them quite efficacious in treating proctitis.

The appearance of a localized abscess in the rectal wall or in the perirectal tissues was closely watched for, but there were no signs of any trouble of this kind. Goodsall concludes "that when an abscess follows the puncture it begins to form within two or three days of the puncture." While this may be considered as a general rule, my case is an exception to it, as the patient had suffered with the acute symptoms for two weeks before coming to me. As a curiosity in this connection, I can also quote a case reported by W. Dutton Akers ("Pin in the Rectum for 30 Years," *Lancet*, 1898, Vol. II, p. 690), in which the patient had suffered for about thirty years with pricking pain in the rectal region on sitting down, constant desire to defecate, and pain on doing so. Besides this, the motions were small, pipe-like and streaked with blood. On examination, considerable induration and inflammation of the rectal mucous membrane were found. Above and to the right side of the internal sphincter, the head and half an inch of the body of a pin was felt, the head projecting upward and across the lumen. The pin was removed with dressing forceps, the removal being followed by rapid and complete cure.

An abscess or fistula is, however, probably the most frequent sequence, as Goodsall found in his twenty cases, three in which an acute abscess was present, while in ten there was either a blind or complete fistula.

If an abscess had been present it would have been freely opened, as is usual, and I wish to call attention here to the importance of thorough examination in all cases of abscesses, as several are reported in which the foreign body acted as an irritant, causing multiple recurrences.

In the case of a fistula, we have found it most satisfactory

to dissect them out carefully, after isolating the sphincter, close the bowel opening with catgut sutures after freshening its edges, and close the external wound with silkworm-gut. The precaution to search out and remove completely any branching fistula must be taken, as otherwise the wound will certainly break down.

A rapid healing will be noted after operation in these cases of fistulæ due to foreign bodies, with any form of operation, if the body is discovered and removed.

28 Elm Street, New Haven, Conn.

## SUMMARIES OR TITLES OF PAPERS BY MEMBERS OF THE HOSPITAL AND MEDICAL SCHOOL STAFF APPEARING ELSEWHERE THAN IN THE BULLETIN.

JAMES J. MILLS, M. D. Retinitis Albuminurica.—*Maryland Medical Journal*, August, 1900.

W. W. FORD, M. D., PH. D. Chills in Typhoid Fever.—*Montreal Medical Journal*, July, 1900.

HUNTER ROBB, M. D. The Use of Rubber Gloves and Gauntlets as a Means of Preventing Infection in Surgery.—*Cleveland Medical Gazette*, August, 1900.

WILLIAM OSLER, M. D. An Address on the Importance of

Post-Graduate Study.—*Lancet*, London, July 14, 1900; *British Medical Journal*, July 14, 1900.

HENRY J. BERKLEY, M. D. The Pathological Findings in a Case of General Cutaneous and Sensory Anæsthesia without Psychical Implication.—*Brain*, Spring, 1900.

EUGENE L. OPIE, M. D. Pathological Changes Affecting the Islands of Langerhans of the Pancreas.—*Journal of the Boston Society of Medical Sciences*, June, 1900.

## PROCEEDINGS OF SOCIETIES.

### THE JOHNS HOPKINS HOSPITAL MEDICAL SOCIETY.

Monday, June 18, 1900.

#### Report of Cases from Children's Clinic.

##### CASE I.—*Tuberculosis following Syphilis*.—DR. AMBERG.

The short history of the case is as follows: A very emaciated colored child, male, 16 months old, with a strongly specific family history, came to the Dispensary with polymorphous syphilitic eruptions of the skin, beginning to appear several months ago, and also with fissures in the lips and ulcers in the mouth, suffering besides with malnutrition and rachitis. The syphilitic manifestations yielded readily to a specific treatment. The examination of the lungs, when first seen, only gave the symptoms of inflammation of the larger bronchi, later presented signs of consolidation of the right posterior part of the lungs. Dr. Booker made the probable diagnosis of tuberculosis guided by the fact that an uncle of the child, living with the family, had died a short while ago from consumption. The disease progressed rapidly and a few days later the child died, 18 months old. The temperature never exceeded 102°.

That syphilitic children acquire tuberculosis is not rare and in this particular case all the circumstances—syphilis of long standing, malnutrition, rachitis, and very bad hygienic conditions—prepared a very favorable soil for the infection.

The post-mortem revealed a disseminated milary tuberculosis. Lungs, pleura, liver, spleen, kidneys and mesenterium are full of milary tubercles. The pleura had on

several places, particularly between the lobes, a thick fibrinous exudation. The trachea has in its lower part an ulcer whose sharply defined and not undermined borders do not show a very characteristic aspect, while lower down on the transition to the left bronchus is a more characteristic ulceration. The left bronchus opens immediately in a cavity nearly reaching the pleura. The bronchial glands are very much enlarged and the one cut open shows caseous degeneration. The rapidity of the course the tuberculosis assumed in this case, the formation of a cavity, the dissemination of the process and the great enlargement of the bronchial glands, make a picture which is not very seldom observed in children up to the second dentition.

##### CASE II.—*Diphtheria with Cardiac Malformation*.—DR. AMBERG.

The second child, white, male, 15 months old, was brought to the Dispensary after having suffered for two days with a croupous cough. On the morning it was taken with severe attacks of dyspnoea, the pharynx was reddened, but without pseudomembranes or patches. A smear made from material taken from the pharynx contained diphtheria-bacilli. Blood-serum inoculated from the same material gave positive results. Dr. Booker performed an intubation, which gave relief after a short time, but the breathing was not perfectly free. Besides, the child got an injection of 1000 units antitoxin. The child remained under observation for 6 days, in which it got 3 times 1000 units of antitoxin. The fever was never high, the pulse always fairly good. The breathing was sometimes

free, mostly difficult, and the tube, which was several times taken out, had to be reinserted, but failed in the last days to give relief to any large extent. The examination of lung and heart was very difficult, owing to violent movements of the chest and the excitability of the child, but a bronchitis extending down to the finer tubes could be detected. The heart sounds were covered by the coarse bronchial rales.

The post-mortem gave the following result: The lungs were edematous, partly emphysematous with areas of bronchopneumonia. The division into lobes is abnormal, the right lung presenting an additional lobe. In the trachea we see the remnant of a false membrane immediately underneath the vocal cords—and two ulcers, one where the tube touched the anterior wall of the trachea and the other further up on the same side, in the height of the cricoid cartilage, not so extensive as the first but of the same aspect and very probably due to the tube too. The spleen has a small additional lobe.

But the most interesting features we find in the heart. The enlargement of the heart is best seen in comparison with the heart of the first child, who was 3 months older. The heart of this older child has a foramen ovale, which is not perfectly closed, but the opening is not very marked and can be demonstrated only by help of a probe. On the right side of the septum in the direction of the vena cava superior is a small pocket formed on one side by the septum, on the other by a thin membrane. It is about 1 cm. long and on the opening about  $\frac{1}{2}$  cm. broad. This opening looks downwards and its border consists of a muscular band. The other heart is enlarged as a whole, but the enlargement of the right side is preponderant. The walls of the heart are hypertrophic. Between the auricles is a wide opening crossed by several fibers coming from the posterior and superior walls of the auricles to the left of the middle-line and spreading fan-like to the anterior and inferior border of the foramen. The fibers are first muscular, but most of them become tendinous. The annulus interauricularis and the valvula foraminis ovalis, which form the secondary septum interatrium are partly deficient, partly badly developed. The annulus interauricularis is running out in a muscular band, which you will see, holding the specimen towards the light, in the superior and posterior wall of the auricles. The origin of the above described fibers and what exists of the valvula foraminis ovalis is to the left of this muscular band. The valvula foraminis ovalis exists only in its upper part as a perforated membrane, showing the direction in which it should have grown by a few fibers. The opening is about the size of a silver quarter.

A remnant of the badly marked valvula Eustachii is to be seen in a fine ligament, running from the right side of the vena cava inferior to the also badly formed limbus Vieussent. On the anterior wall, where the bulbus aortae lies against the wall, are several muscular bands irregularly arranged, leaving small spaces between them, where muscular fibers are apparently wanting. There are no other irregularities to be noticed; the myocard and endocard seem to be in perfectly good order.

The occurrence of these large openings between the auricles without any other lesion of the heart is not frequent, as

Peacock stated, and as it is particularly emphasized by Fallot, who found in the reports of 10 years of the Bulletin de la société anatomique and Bulletin des Hopitaux de Paris only 3 cases.

Two explanations are given for the malformations of the heart. One considers the malformation as a consequence of a foetal endocarditis, the so-called anomalies subordonnées. I think we can rule out the foetal endocarditis in this case, because there is nothing in the heart to justify this explanation, while the other irregularities found in lung and spleen lead us naturally to the other explanation and we may attribute the malformation to an arrest of development. Moussons is inclined to think, that perhaps too many cases have been ascribed to a foetal endocarditis, recalling Rokitsansky's experience, who found that alterations of myocard and endocard are rare or little marked in very young or still-born children, while more frequent and better marked in older children or adults afflicted with malformation of the heart. Further, Moussons points out that the endocarditis may be secondary, an idea already brought forward among others by Rauchfuss, who states that a malformation may give a predisposition for a foetal endocarditis, explaining so that the foetal endocarditis is oftener found in the right heart.

I will give shortly the way in which Rokitsansky tried to explain the malformation in question, when there is, as in our case, no stenosis of the pulmonary artery. He argues thus: While the septum interatrium is formed the septum interventriculare is not yet closed. If there exists now a malproportion between the pulmonary artery and the aorta, so that the aorta is relatively too narrow, a part of the blood of the left ventricle will flow through the opening of the septum interventriculare into the right ventricle, causing dilatation and relative insufficiency of the tricuspidal valve. There follows dilatation of the right auricle and of the part forming the transition from the right to the left auricle and the dilatation is made responsible for the prevention of the perfect formation of the septum interatrium. After the closure of the septum interventriculare the left ventricle will become dilated and the walls hypertrophic. As the cause of the narrowing of the aorta, Rokitsansky regards a failure of development. Rokitsansky does not claim that this explanation is always found valid, saying, that there are cases where the septum interatrium was found closed under more unfavorable conditions. In our case the circumference of the pulmonary artery in the valvular region—the heart was preserved in alcohol—is 4.5 cm., that of the aorta 3.0, while the corresponding figures of the other heart are 4.2 to 3.0 cm. If this condition allows the explanation, Rokitsansky's is very questionable. He thinks it is important that the septum is generally pushed to the left, an impression we get undoubtedly in our case, so indicating, that it yields to a pressure exercised from the side of the right auricle.

Several etiological factors are claimed to be important. Heredity is made responsible in several cases direct or indirect; syphilis, tuberculosis, rheumatism, pneumonia of the parents were suspected in others. Besides we find accused marriages between near relatives, rachitis and nervous



diseases of the parents. Of all these etiological factors none can be made responsible in this case. Another fact remains to be mentioned, the child was never blue before it was taken sick with the attacks of dyspnoea. This confirms again the observation of the authors, who found that even a wide opening between the auricles is not necessarily followed by cyanosis. Fallot particularly has noted that the malformation in question only exceptionally leads to the "maladie bleue." It is well known that a malformation like this is not a danger to life and it may allow even hard labor. That the malformation of this heart is in any way connected with the fatal end, is doubtful. Nevertheless, it is probable that the already much enlarged heart had not the power of resistance, like a perfectly normal one, and that it succumbed therefore more readily to the diphtheritic virus and the weakening influences of the bronchopneumonia.

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#### Thrombosis of Carotid Artery.

DR. CUSHING. The patient was a colored man, 52 years of age, who came in last fall with the diagnosis of a tuberculous ulcer in the bladder. He was operated upon Dec. 30, a suprapubic cystotomy being performed with the patient in the Trendelenberg position. The ulcer was excised and the wound in the bladder closed as is usual when there is no particular infection of the urine and nothing to indicate the necessity for keeping the bladder open. He made a very good recovery from the anesthetic and was left sleeping comfortably that evening. About midnight, however, Dr. Baer, who had him in charge, called me to see the patient, saying that he was stupid and dull. We found that he had a definite hemiplegia which we supposed was due to a cerebral hemorrhage. The left side of the face was completely paralyzed. The left arm was flexed and quite rigid, as was also the left leg. The respirations were Cheyne-Stokes in character. On the following day the whole left side became flaccid and he

presented the characteristics of a hemiplegic. The paralysis of the left side was complete, except for the supraorbital muscle. For twelve days he went on without change in the symptoms; the bladder healed up completely and we supposed the paralysis would also clear up. On Jan. 13 there was a sudden rise of temperature with pain in the back of the head and neck. Lumbar puncture was made and clear fluid withdrawn; no cellular elements present and no organisms detected. Forty-eight hours after this exacerbation paralysis of the cervical sympathetic was apparent and on the next day a pronounced swelling of the whole upper extremity began and extended over the chest. We supposed there was a thrombosis of the jugular vein and that possibly it had extended downwards from the cavernous sinus. The patient gradually failed and died that night.

The pathological findings showed a thrombosis of the carotid artery and almost the whole right hemisphere was involved in a white softening. There was no apparent arteriosclerosis noted clinically nor at the autopsy.

Whether his position at the time of operation could have had any predisposing effect I do not know, but I believe that such post-operative calamities are practically unheard of on the gynecological side where that position is so frequently used.

DR. PATON.—On inspection of the external surface of the right hemisphere it can be easily seen even that there is a large area of softening. This area corresponds to the distribution of the Sylvian artery, leaving out the superior temporal and the superior frontal convolutions. On the inner surface the region supplied by the anterior cerebral is very firm and apparently not involved. The posterior cerebral supply is not affected. It is evident that the whole carotid area is not involved, but only that part of it which is supplied by the Sylvian artery.

The microscopic examination of the tissues brings out some interesting points. Sections taken from the right frontal convolution show no trace of nerve cells, but in their place are great numbers of cells similar to those found in all softened areas. One does not care to say anything definitely concerning the origin of these cells as it is an old question of dispute. Without doubt the vascular system supplied some, and the neuroglia tissue, others. Then there is a cell element that I believe will sooner or later be shown to have an important relation to these conditions, and that is the indifferent cell which exists in such great numbers in the adult nervous system. Some of these cells may persist as indifferent cells through life and some may become neuroglia cells.

The cells in the motor area on the right side show only very slight changes.

## THE JOHNS HOPKINS HOSPITAL BULLETIN.

The Hospital Bulletin contains details of hospital and dispensary practice, abstracts of papers read, and other proceedings of the Medical Society of the Hospital, reports of lectures, and other matters of general interest in connection with the work of the Hospital. It is issued monthly.

Volume XI is now in progress. The subscription price is \$1.00 per year. The set of ten volumes will be sold for \$20.00.

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## GENERAL STATEMENT.

The Medical Department of the Johns Hopkins University was opened for the instruction of students October, 1893. This School of Medicine is an integral and coordinate part of the Johns Hopkins University, and it also derives great advantages from its close affiliation with the Johns Hopkins Hospital.

The School begins on the first of October and ends the year on the first of September.

In the Dispensary and Wards of the Hospital,

the medical art should rest upon a suitable

course are devoted mainly to practical work, con-

atomy, Physiology, Physiological Chemistry,

an abundant opportunity for the personal study

of Laboratories, Especially advantageous for

practical work in the Dispensary, and throughout

## ERRATUM.

In Dr. Welch's article, p. 186 (Vol. XI) of the BULLETIN, line 5 of footnote 14, "constantly" should read "inconstantly."

degree in this university.

acquaintance with Latin and a good reading

is imparted by the regular minor courses given

(tion. In physics, four class-room exercises and

five hours a week in the laboratory in each

those who give evidence by examination that they possess the general education implied by a degree in arts or in science from an approved college or scientific school, and the knowledge of French, German, Latin, physics, chemistry, and biology above indicated.

Applicants for admission will receive blanks to be filled out relating to their previous courses of study.

They are required to furnish certificates from officers of the college or scientific schools where they have studied, as to the courses pursued in physics, chemistry and biology. If such certificates are satisfactory, no examination in these subjects will be required from those who possess a degree in arts or science from an approved college or scientific school.

Candidates who have not received a degree in arts or in science from an approved college or scientific school will be required (1) to pass, at the beginning of the session in October, the matriculation examination for admission to the college department of the Johns Hopkins University, (2) then to pass examinations equivalent to those taken by students completing the Chemical-Biological course which leads to the A. B. degree in this University, and (3) to furnish satisfactory certificates that they have had the requisite laboratory training as specified above. It is expected that only in very rare instances will applicants who do not possess a degree in arts or science be able to meet these requirements for admission.

Hearers and special workers, not candidates for a degree, will be received at the discretion of the Faculty.

## ADMISSION TO ADVANCED STANDING.

Applicants for admission to advanced standing must furnish evidence that the foregoing terms of admission as regards preliminary training have been fulfilled, (2) that courses equivalent in kind and amount to those given here, preceding that year of the course for admission to which application is made, have been satisfactorily completed, and (3) must pass examinations at the beginning of the session in October in all the subjects that have been already pursued by the class to which admission is sought. Certificates of standing elsewhere cannot be accepted in place of these examinations.

## SPECIAL COURSES FOR GRADUATES IN MEDICINE.

Since the opening of the Johns Hopkins Hospital in 1889, courses of instruction have been offered to graduates in medicine. The attendance upon these courses has steadily increased with each succeeding year and indicates gratifying appreciation of the special advantages here afforded. With the completed organization of the Medical School, it was found necessary to give the courses intended especially for physicians at a later period of the academic year than that hitherto selected. It is, however, believed that the period now chosen for this purpose is more convenient for the majority of those desiring to take the courses than the former one. The special courses of instruction for graduates in medicine are now given annually during the months of May and June. During April there is a preliminary course in Normal Histology. These courses are in Pathology, Bacteriology, Clinical Micro-

scopie, General Medicine, Surgery, Gynecology, Dermatology, Diseases of Children, Diseases of the Nervous System, Genito-Urinary Diseases, Laryngology and Rhinology, and Ophthalmology and Otolaryngology. The instruction is intended to meet the requirements of practitioners of medicine and is almost wholly of a practical character. It includes laboratory courses, demonstrations, bedside teaching, and clinical instruction in the wards, dispensary, amphitheatre, and operating-rooms of the Hospital. These courses are open to those who have taken a medical degree and who give evidence satisfactory to the several instructors that they are prepared to profit by the opportunities here offered. The number of students who can be accommodated in some of the practical courses is necessarily limited. For those the places are assigned according to the date of application.

During October a select number of physicians will be admitted to a special class for the study of the important tropical diseases met with in this region.

The Annual Announcement and Catalogue will be sent upon application. Inquiries should be addressed to the

REGISTRAR OF THE JOHNS HOPKINS MEDICAL SCHOOL, BALTIMORE.

diseases of the parents. Of all these etiological factors none can be made responsible in this case. Another fact remains to be mentioned, the child was never blue before it was taken sick with the attacks of dyspnoea. This confirms again the observation of the authors, who found that even a wide opening between the auricles is not necessarily followed by cyanosis. Fallot particularly has noted that the malformation in question only exceptionally leads to the "maladie bleue." It is well known that a malformation like this is not a danger to life and it may allow even hard labor. That the malformation of this heart is in any way connected with the fatal end, is doubtful. Nevertheless, it is probable that the already much enlarged heart had not the power of resistance, like a perfectly normal one, and that it succumbed therefore more readily to the diphtheritic virus and the weakening influences of the bronchopneumonia.

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Charcot, Bouchard, Brissaud: Traité. V, 1893.

#### Thrombosis of Carotid Artery.

DR. CUSHING.—The patient was a young man, who came in last fall with the diagnosis of an ulcer in the bladder. He was operated on by suprapubic cystotomy being performed in the Trendelenberg position. The ulcer was excised and the wound in the bladder closed as is usual when there is no particular infection of the urine and nothing to indicate the necessity for keeping the bladder open. He made a very good recovery from the anesthetic and was left sleeping comfortably that evening. About midnight, however, Dr. Baer, who had him in charge, called me to see the patient, saying that he was stupid and dull. We found that he had a definite hemiplegia which we supposed was due to a cerebral hemorrhage. The left side of the face was completely paralyzed. The left arm was flexed and quite rigid, as was also the left leg. The respirations were Cheyne-Stokes in character. On the following day the whole left side became flaccid and he

presented the characteristics of a hemiplegic. The paralysis of the left side was complete, except for the supraorbital muscle. For twelve days he went on without change in the symptoms; the bladder healed up completely and we supposed the paralysis would also clear up. On Jan. 13 there was a sudden rise of temperature with pain in the back of the head and neck. Lumbar puncture was made and clear fluid withdrawn; no cellular elements present and no organisms detected. Forty-eight hours after this exacerbation paralysis of the cervical sympathetic was apparent and on the next day a pronounced swelling of the whole upper extremity began and extended over the chest. We supposed there was a thrombosis of the jugular vein and that possibly it had extended downwards from the cavernous sinus. The patient gradually failed and died that night.

The pathological findings showed a thrombosis of the carotid artery and almost the whole right hemisphere was involved in a white softening. There was no apparent arteriosclerosis noted clinically nor at the autopsy.

Whether his position at the time of operation could have had any predisposing effect I do not know, but I believe that such post-operative calamities are practically unheard of on the gynecological side where that position is so frequently used.

convolution show no trace of nerve cells, but in their place are great numbers of cells similar to those found in all softened areas. One does not care to say anything definitely concerning the origin of these cells as it is an old question of dispute. Without doubt the vascular system supplied some, and the neuroglia tissue, others. Then there is a cell element that I believe will sooner or later be shown to have an important relation to these conditions, and that is the indifferent cell which exists in such great numbers in the adult nervous system. Some of these cells may persist as indifferent cells through life and some may become neuroglia cells.

The cells in the motor area on the right side show only very slight changes.

### THE JOHNS HOPKINS HOSPITAL BULLETIN.

The Hospital Bulletin contains details of hospital and dispensary practice, abstracts of papers read, and other proceedings of the Medical Society of the Hospital, reports of lectures, and other matters of general interest in connection with the work of the Hospital. It is issued monthly.

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In the methods of instruction especial emphasis is laid upon practical work in the Laboratories and in the Dispensary and Wards of the Hospital. While the aim of the School is primarily to train practitioners of medicine and surgery, it is recognized that the medical art should rest upon a suitable preliminary education and upon thorough training in the medical sciences. The first two years of the course are devoted mainly to practical work, combined with demonstrations, recitations and, when deemed necessary, lectures, in the Laboratories of Anatomy, Physiology, Physiological Chemistry, Pathology, Pharmacology, Pathology and Bacteriology. During the last two years the student is given abundant opportunity for the personal study of cases of disease, his training being spent largely in the Hospital Wards and Dispensary and in the Clinical Laboratories. Especially advantageous for thorough clinical training are the arrangements by which the students, divided into groups, engage in practical work in the Dispensary, and throughout the fourth year serve as clinical clerks and surgical dressers in the wards of the Hospital.

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As candidates for the degree of Doctor of Medicine the school requires:

1. Those who have satisfactorily completed the Chemical-Biological course which leads to the A. B. degree in this university.
2. Graduates of approved colleges or scientific schools who can furnish evidence: (a) That they have acquaintance with Latin and a good reading knowledge of French and German; (b) That they have such knowledge of physics, chemistry, and biology as is imparted by the regular minor courses given in these subjects in this university.

The phrase "a minor course," as here employed, means a course that requires a year for its completion. In physics, four class-room exercises and three hours a week in the laboratory are required; in chemistry and biology, four class-room exercises and five hours a week in the laboratory in each subject.

Those who give evidence by examination that they possess the general education implied by a degree in arts or in science from an approved college or scientific school, and the knowledge of French, German, Latin, physics, chemistry, and biology above indicated.

Applicants for admission will receive blanks to be filled out relating to their previous courses of study.

They are required to furnish certificates from officers of the college or scientific schools where they have studied, as to the courses pursued in physics, chemistry and biology. If such certificates are satisfactory, no examination in these subjects will be required from those who possess a degree in arts or science from an approved college or scientific school.

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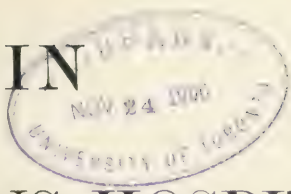
Record of Deaths occurring in the Gynecological Department from June 6, 1890, to May 4, 1892.



# BULLETIN

OF

## THE JOHNS HOPKINS HOSPITAL.



Vol. XI.—No. II6.]

BALTIMORE, NOVEMBER, 1900.

[Price, 15 Cents.

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## ANEURISM OF THE AORTA TREATED BY THE INSERTION OF A PERMANENT WIRE AND GALVANISM [MOORE-CORRADI METHOD].

WITH A REPORT OF FIVE CASES.

By GUY L. HUNNER, M. D.,

*Assistant Resident Gynecologist, The Johns Hopkins Hospital.*

The study of the literature concerning aneurism of the aorta convinces me that this dreadful malady is usually a surgical disease. The authenticated spontaneous cures are sadly few in number. Clinical experience demonstrates that we can extend but little hope to a patient in proposing the palliative method of Bellingham<sup>1</sup> commonly known as the Tufnell<sup>2</sup> treatment. Moreover, this treatment, as well as its modification by the use of potassium iodid as proposed by Balfour,<sup>3</sup> to be properly carried out, requires first, a patient of more than ordinary hardihood, and secondly, conditions with which it would be impossible to surround the average patient. With these facts before us, and a surgical measure at hand with which there is considerable chance for success it may be questioned whether we are justified in allowing these cases of aortic aneurism to go without operative interference.

It is impossible in a paper of this scope to enter into the merits of the various methods of treatment now in vogue, for we may be permitted a hurried survey of the subject. We are confining our remarks to aneurism of the aorta. For those aneurisms of the vessels of smaller and intermediate size easily reached by the surgeon, it is probable that the Hunterian treatment by ligature will long continue the preferable method.

Ligation of the aorta, reported in ten cases<sup>4</sup> as performed for aneurism, has been universally fatal, the patients living from 4 hours to 11 days.

Pringle<sup>5</sup> refers to five cases of abdominal aneurism, probably all of the aorta, successfully treated by proximal pressure. Manifestly thoracic aneurisms cannot be so treated, and he recognizes the fact that most abdominal aneurisms arise about the celiac axis and cannot be treated by proximal pressure. Pringle would limit this method to those aneurisms which arise below the aortic bifurcation. He quotes results in five cases of abdominal aneurism treated by distal compression. Death followed in these cases from peritonitis, obstruction of the bowels, gangrene, and reduction of the pancreas to a pulp.

The method of Cinicelli<sup>6</sup> of galvano-puncture or electrolysis was first suggested independently by Velpeau<sup>7</sup> and by Benjamin Phillips<sup>8</sup> and is still being used with more or less success, principally by the Italians. Another method in vogue in Italy is that of Baccelli<sup>9</sup> who introduces several steel watch springs into the sac and allows them to remain.

The only other surgical method worthy of consideration is that successfully practised by Maccewen,<sup>10</sup> of nodding the inner lining of the sac and waiting for the thrombus formation



and, according to Macewen, organization. Given an aortic aneurism of small size with the three coats and their vasa vasorum, and this method offers some chances for cure. But the process requires from a few to 48 hours for the needling and from weeks to months for the thrombus formation, even in the most favorable sac. Moreover, the strengthening of the wall takes place where the point of the needle plays rather than on the anterior wall, where, in aneurism of the thoracic aorta, at least, there seems to be the most frequent extension. Manifestly in abdominal aneurism only those sacs which lie in immediate contact with the parietes could be so treated and the certain diagnosis of such a condition is quite an impossibility.

The brilliant results reported by the French<sup>11</sup> authors in the use of the gelatin method have not been confirmed in our wards. With Dr. Fitcher<sup>12</sup> we believe the method deserves further trial and would recommend it if a patient presents himself before being in a desperate condition. Dr. Finney suggests that future experience may prove the advisability of giving a few gelatin injections shortly before operation by the Moore-Corradi method.

In the year 1864 Mr. Charles H. Moore of the Middlesex Hospital first attempted the cure of an aortic aneurism by the insertion of a permanent foreign body.

That this hazardous operation was undertaken only after careful consideration of the principles involved, is evidenced by his observations; to wit, "the first indispensable condition for the cure of thoracic aneurism is to provide means of eliciting fibrin from the blood," and, "the second indispensable condition for relieving an aortic aneurism is to extend the surface within it on which fibrin may coagulate."

Nothing daunted by a failure in his first case, due to the then obscure agent sepsis, he says:—"if there be no manifest and essential fault in the procedure I cannot think it right to abandon an operation which was so promptly followed by the most marked and positive improvement. On the contrary, I regard its early results as strikingly confirming the main part of the theory and as affording for other cases a substantial promise of advantage from which future thought has but to eliminate the cause of ill success." And he suggested two very important improvements in technique: (1) that a less quantity of wire be used (he used 78 feet) and (2) that the wire be so manipulated as to insure its coiling in the cavity and not merely lying in circles against the walls.

Since Moore's failure the application of aseptic surgery has removed the greatest "cause of ill success" and the addition of electrolysis as suggested by Corradi has been a marked improvement in method.

*Method.*—While this operation was devised by an Englishman and modified by an Italian, it has been developed principally by Americans. And among these Dr. D. D. Stewart, of Philadelphia, deserves most credit for his activity in evolving a good technique.

In his preparation for an operation the surgeon should experiment beforehand with his needles, wire, and electrical apparatus, to find which he can manage with the greatest

facility and effectiveness. The needles should be considered with regard to size, material, insulation and sterilization. One chooses between the cannula with trocar, and the lance-pointed aspirator needle, which latter may be inserted alone or with the initial end of the wire already introduced. Within limits the needle should be large enough for the easy passage of the wire. The loss of blood, if the wire be inserted with the needle, or soon after, is very slight and most aneurism patients would probably be benefited by some bleeding.

As to insulation, the needle should be covered from the shoulder to within 1 cm. of the point, with some non-conducting material, so that the electrical current will not be dissipated when the needle passes through the sac wall. Duncan<sup>13</sup> after trying glass, sealing-wax, varnish of various kinds, caoutchouc, and shellac, advised covering the needle with vulcanite; but hard rubber cannot be properly used without materially increasing the caliber of the needle. Our needles were covered neatly and effectively with a black varnish or lacquer. ("Best French Lacquer," made by Behlen & Bro., New York City.) This cannot be boiled nor will it bear soaking in carbolic. It softens in the steam sterilizer either with or without pressure but quickly hardens on exposure to dry air; so this method may be used. But the best method is to sterilize in a dry-air chamber. One should select a half-dozen needles of various sizes and lengths; have them lacquered; place them in a test-tube, and cork with cotton. This is placed in a hot-air chamber, the temperature raised to 160 degrees C., and allowed to remain there one hour. The test-tube is kept corked until time for the operation, when the needles are emptied out on a dry sterile towel or plate.

In selecting wire one considers the amount to be used, its size and its composition. The recognition of a few general principles will aid in its selection. (1) The disposition of the wire in the lumen of the sac is an important factor in the amount and effectiveness of the fibrin whipped out. A small quantity of fine wire possessing a good spring should be selected. (2) Cure of the aneurism demands as complete contraction as possible of the sac wall upon the clot formed at or soon after the operation. The wire should be of such amount and material as not to interfere seriously with this contraction. (3) The corrosion of the wire by the electric current makes a rough surface very conducive to the rapid whipping out of fibrin. Within limits the wire most easily corroded is to be preferred.

One can gain many valuable points regarding wire and needles, and acquire a facility in their management by experimenting on a few glass flasks varying in capacity from 200 to 500 cc. and stoppered with ordinary corks. The needle is pushed through the cork, and the wire, after being wound on a spool and boiled as described in Finney's first case, is passed into the flask. It will be found that 10 feet of fine wire with a lively spring, effectually meshes the lumen of a 500 cc. flask. By reference to the literature we find that no more than 10 feet of wire were used in the successful cases. But we believe 20 feet might be used in some cases and Dr. Stewart is of the same opinion (see report of his fourth case).

Steel wire takes a better coil than pure silver, even after the latter is highly drawn. But steel is stiff for manipulation, has a high resistance, and, theoretically at least, would interfere with the contraction of the sac. Soft iron wire, as shown by the experiments of Stevenson,<sup>1</sup> decomposes very rapidly under the electric current and, as demonstrated by Stewart, it is probable that the detritus given off would be a source of danger in the capillary circulation. The undrawn silver has scarcely any tendency to coil after passing the needle, and either jams from side to side as it meets the resistant glass walls, thus only partially getting into the lumen, or takes the broadest coil possible about the periphery. We have not worked with gold wire as used by Stewart and others.

After considerable experimenting in conjunction with Mr. Frank Persohn, who makes the wire used in the hospital surgical work, we found a silver alloy, highly drawn, to be quite ideal;<sup>2</sup> 75 parts of copper to the thousand makes a wire which when drawn from No. 8 to No. 27 (standard gage) takes a closer coil than steel (see photograph). It is more pliant than steel, thus minimizing the danger of puncture should the end come in contact with the thin aneurismal wall. It has more body than the pure silver of equal drawing, and is therefore more easily passed into the needle without kinking. It corrodes much more than steel, thus forming a rougher surface for the whipping out of fibrin. We believe, however, that the fibrin formation is far more a chemical than a mechanical process; and silver, being one of the least resistant of all metals to the electric current, transmits more of a given current for action on the blood.

With regard to electrical apparatus we have found the galvanic battery of the Baltimore Chlorid of Silver Dry Cell Battery Company a compact, simple and effective instrument. It rests on a small table near the anæsthetist and by means of its insulated conducting cords is connected—the positive pole to a long end of the wire from the aneurismal sac, the negative pole to a metal plate at the back. This plate should be well covered with several layers of towel kept moist throughout the operation.

*Never should the sac receive both poles, nor should the current be so passed that the negative electrode is in the sac.* Duncan, and later Stevenson, in the papers above cited have shown that about the negative pole there accumulates "a yellow, friable, alkaline, mass composed to a great extent of gas bubbles which very quickly break down." While about the positive pole "the clot is smaller, firmer, and darker in color, and has an acid reaction."

Abbe by reversing the current toward the close of his operation probably softened the clot already formed by the positive current.

*Experiments.*—We wish to supplement these remarks on method with the results of a few experiments made with the view to determine the effects of the electrical current on dif-

ferent wires and on the blood. Taking to the abattoir two batteries and both steel and silver wire we had fresh hog's blood caught in two glass jars which had been thoroughly cleaned and vaselined. We were surprised at the almost instantaneous coagulation of the blood, but in spite of this phenomenon we had no difficulty in placing our wires. A coil to receive the positive current was pushed down into the center of the jelly-like mass, and the negative wire was carried to the bottom of the jar through a fine glass tube inserted at the periphery of the clot.

The batteries being connected, a current of 100 ma. was passed through each clot. The current through the steel wire remained practically constant for an hour, while towards the end of this time that through the silver wire grew less, as explained below. The action of the powerful current was immediately manifested about the negative wires where their ends projected from the glass tubing. Here there was a rapid formation of water, an active ebullition of gas bubbles, and finally a large excavation in the bottom of each clot.

At the end of an hour the rolls of coagula were slipped out of the jars and the wire coils examined. These showed a marked action of the positive current. The steel wire was surrounded throughout its length by a zone of adherent blackened material three or four millimeters in width. The wire was corroded and of slightly smaller caliber but still retained its form and resistant spring. The silver wire presented a more decided picture. The charred coagulum about the wire was of greater width than that about the steel wire, and the wire itself had suffered such corrosion that it broke easily in attempting to free the clot. We wondered why the galvanometer registering for the silver wire should drop during the last quarter hour from 100 to 50 ma., and here was the explanation in the reduced caliber of the wire.

To test the coagulating power of the electrical current we decided to try partial tying off of a dog's aorta at two different points, hoping thereby to get a slowing of the current and some dilatation between the points of partial ligation. Partial tying at the bifurcation did not cause appreciable dilatation above, nor was a sac imitated when another partial ligation was placed just below the renal arteries. The latter ligation was discarded and the lower ligation tightened to entirely close the lumen at the bifurcation. This caused an appreciable increase in tension and possibly some dilatation. A strong current was flowing because of the renal, ovarian, and numerous small lumbar arteries.

An insulated needle was inserted just above the ligation with its point toward the dog's heart and a number 5 (music gauge) steel wire easily inserted. The wire quickly perforated and we had to withdraw the needle and tie off above the perforation. We then loaded the needle to its point with a pure silver wire (drawn), of the same size (No. 27 standard gauge), and inserted the needle to its hilt. This carried the wire above the renal arteries where it was left by simply slipping the needle back to its point of entrance. With the positive pole connected with this wire and the negative to a large metal plate under the dog's shoulders a current of 50 ma. was

<sup>1</sup> This work was done immediately after Dr. Halsted's case in the winter of '97-'98. Reeve shortly afterward experimented with various kinds of wire and arrived at the same conclusion with regard to the propriety of the silver alloy.

passed for ten minutes, then a current of 65 ma. for ten minutes, increasing to 80 ma. and keeping it there for twenty minutes. At the end of this 10 minutes the wire could be felt distinctly larger. The current was stopped and the dog quickly killed with the anæsthetic. On dissecting out the aorta from the diaphragm to the bifurcation and opening it the wire was found to be covered by a coating of reddish yellow fibrin, varying from 1-2 mm. in thickness. This was rather firmly adherent to the wire, coming off in strings when pulled away. The wire was considerably corroded, fine bits of silver coming off with the fibrin and more being scraped off with the finger nail.

Being convinced by various observations that the current generally used is stronger than necessary and even dangerous (see autopsy report, Dr. Finney's first case) I tried in a dog's aorta the effect of a 20 ma. current for an hour. This caused apparently the same amount of coagulum as described in the foregoing experiment, but possibly the fibrin was not as firm as that formed by the stronger current. The wire was blackened and slightly corroded. On another dog 10 ma. were passed for one hour with similar results. In the case of a wire left in the aorta for an hour with no galvanism the wire collected no fibrin.

In order to observe more carefully the effect of different currents upon the aortic wall, two dogs were prepared as above, and currents of respectively 100 ma. and 20 ma. were passed for an hour. Both wires collected about the same quantity of fibrin. The aortic wall subjected to the stronger current showed decided destruction of tissue wherever the wire came in contact with it, while that of the weaker current was merely discolored in similar situations.

We shall dwell but briefly upon the operation itself as the points are covered more thoroughly in our report of cases. In thoracic aneurism one of the greatest claims of this method over that of distal ligation is the fact that the patient does not require an anæsthetic.<sup>2</sup> This is particularly advantageous in cases of dyspnoea and bronchitis from pressure on the trachea. Locally cocaine or ethyl chlorid may be used. Usually the needle is inserted where the sac wall seems nearest the exterior surface. If there be more than one point of bulging and it be suspected that a multilocular or very large sac is being dealt with it would be advisable as suggested by Stewart to pass wires at more than one point and attach the positive pole to each. The needle should be inserted as nearly as possible with the direction of the entering current and away from the mouth of the sac. If a kink occur after some wire is in, one inserts another needle and after passing the required amount of wire both wires are attached to the positive pole.

For the abdominal cases make the usual preparations for celiotomy. Be particularly careful to clear the intestines in order to have the field of operation as free as possible. The method of exposure of the sac will have to be determined for

the different organs, the adhesions present, the direction in each case according to the position of the sac, its relations to which the needle should be passed and other contingencies that arise after opening the peritoneal cavity.

We present below a brief summary of all cases treated both by Moore's method of wire alone, and by the method of Corradi in which electrolysis was used.

#### ABSTRACT OF THE CASES TREATED BY THE WIRE (MOORE'S) METHOD.

CASE I.—Moore: 1864. *Medico-Chirurgical Transactions* (Lond.), Vol. XLVII, p. 129.

Man; aged 27. Aneurism of the ascending aorta. Connected with this by openings in second and third interspaces, an extra thoracic aneurism of large size, increasing and threatening to burst.

*Operation.*—Twenty-six yards fine iron wire introduced through canula and pushed entirely in by blunt trocar; one hour; no pain; a slight and transient feeling of faintness; not over one-half ounce of blood lost.

*Effect.*—Pulse reduced from 116 to 92, almost complete cessation of pulsation, and a diminution in size of tumor. Nine hours later patient asleep and pulse 78. On the next day the patient was seized with rigors and high fever, and died the fifth day with symptoms of sepsis.

*Autopsy.*—"Interior of tumor filled, for the most part, with a fibrinous coagulum, enveloping and embedded in the coils of wire, and firmly adherent to the surrounding walls."

CASE II.—Domville: 1871. *Lancet* (Lond.), Vol. III, p. 287.

Man; aged 40; a private in the Royal Marines, employed as a shoemaker. Two pulsating tumors of the size of half-oranges, projecting two and one-half inches from the chest, one on either side of sternum, about on level with nipple-line. Three months' treatment by iron, sedatives and iodid of potassium pushed to iodism. Tumor increased and "rupture became imminent."

*Operation.*—Fourteen inches fine iron wire passed through canula into tumor from left side, wire being passed until resistance was felt.

*Effect.*—At first seemed decidedly beneficial, the tumor becoming firmer and the impulse and discoloration less; but five days later the bulging again increased and the sac thinned so greatly in two weeks that oozing began from the site of puncture, and the patient died one month after operation from rupture and sudden profuse hæmorrhage from the sac.

*Autopsy* revealed a fusiform dilatation of the whole arch; and arising from this, at a point two inches above the valves, a large sacular dilatation. Springing from this large sac was a second but smaller sac which had eroded the sternum on the left and formed the visible pulsating tumor. The wire was found coiled in the form of a figure eight, lying imbedded in coagulum on the bottom of this outer sac.

CASE III.—Murray: 1872. *British Medical Journal*, 1872, Vol. I, p. 596.

Thoracic aneurism, first treated by needling, then by the insertion of catgut, and finally by Moore's method, 24 feet of wire being inserted. Patient died in three weeks.

CASE IV.—Rubio: 1874. *British Medical Journal*, 1886, Vol. I, p. 395.

Case of innominate aneurism; treated by 8 feet of iron wire; showed no change of symptoms during the first four days; was then lost sight of; presumed to have died.

CASE V.—Loreta: 1885. *Memoirs "Royal Academy"* Bologna, Vol. 6, Series IV; Abstract *British Medical Journal*, 1885, Vol. I, pp. 745 and 955.

<sup>2</sup> Revere and Schleich's solution for his case, and Dr. Finney wired an abdominal case October 19, 1900, using the same anæsthesia.



Sailor; aged 30; syphilis 5 years before. Large abdominal aneurism filling epigastrium and left hypochondrium.

*Laparotomy.* Six feet fine silvered copper wire through a fine trocar. Rapid, progressive recovering. Patient passed a good night after the operation, the first in two months. Pulsation diminished same night, and the femoral pulse, before almost suppressed, reappeared. Left hospital, well, ten weeks after operation with walnut-sized hard mass in place of the large pulsating sac.

Died thirteen weeks after operation from rupture of aorta at inferior angle of junction of sac with aorta.

CASE VI.—Cayley: 1886. *Medico-Chirurgical Transactions* (London), Vol. LXIX, p. 267.

Sailor; aged 48. Rheumatic gout; alcoholic; syphilis 27 years before. A hen's-egg-sized, oval, elastic, pulsating tumor rising three inches into neck above right sterno-clavicular articulation. Tracheal pressure symptoms. Rigid Tufnell's diet, rest, iodid of potassium. Aneurism threatening to burst; Mr. Hulke passed 40 feet fine steel wire, resulting in complete consolidation of external portion. Exterior of tumor backward and to left, threatening death by pressure on trachea. Six weeks later Mr. Gould passed 35 feet of wire into tumor which had appeared in the left sterno-clavicular region. No improvement; death nine days later from dyspnoea, due to tracheal pressure.

*Autopsy* revealed very large aneurism arising by large opening from a dilated ascending arch. The wires from both operations were imbedded in firm pinkish clot and separated from the main blood stream and the red post-mortem clot by a layer of firm decolorized fibrin. The opening from the aorta into the aneurism was so large that the lower portion of the sac still received a strong blood current and made the fatal pressure on trachea.

CASE VII. Lange: 1886. *Medical News* (Phila.), Vol. XLIX, p. 582. See also *New York Medical News*, Nov. 21, 1886.

An abdominal aneurism upon which Lange proposed imitating Loret's procedure; but, there being evidence of rupture of the aneurism, Lange passed 9 feet of thin wire without laparotomy. This probably caused a shunting of more blood through the bleeding portion of the sac, for in a few days a large pulsating area appeared in the right lumbar region. Twenty-four feet of wire were passed into the pulsating area. Death twelve days after operation, from pneumonia.

*Autopsy.*—A double fist-sized aneurism, situated just below diaphragm, communicating with the aorta through a lengthy opening on the posterior side of this vessel. The walls of the sac were quite firm from organized fibrin. The sac was ruptured on the right side. The original sac contained an immense clot about the wire. The wire introduced into the second pulsating area, or that in the lumbar region, was quite free from clot.

CASE VIII.—Ransohoff: 1886. *Medical News* (Phila.), Vol. XLVIII, p. 597.

Colored man; aged 35. Moderate drinker. Admits having had chancroids, but denies syphilis. A fist-sized, pulsating conical swelling, occupying second and third right interspaces. Slight exertion often followed by severe paroxysms of dyspnoea that threaten to terminate life. Dyspnoea and oedema of right shoulder region make anæsthetic and distal dissection impracticable.

*Operation.*—Eight feet flexible silver wire passed through canula; syncope after 4 feet had passed. Great amelioration of all symptoms; two weeks later patient became worse; sternal side of tumor increased in size; 8 feet of wire into this portion; death one month after first operation.

*Autopsy.*—Aneurism of ascending portion of arch, anterior sur-

face; dimensions, 7 x 4 inches; mouth of sac an inch in diameter. Aneurism ruptured on posterior lateral wall into right pleural cavity. Wire covered by recent coagulum. One loop had passed through the aortic opening and rested just above, and in close relation to one of the leaflets of the aortic valves. Hence the syncope during the first operation.

CASE IX.—Morse: 1887. *Pacific Medical and Surgical Journal*, Feb., 1887; *Abstract in Medical News*, Phila., March, 1887.

American; aged 32. No history of syphilis or alcoholism. History of traumatism. Improved on rest, diet and iodid of potassium. Returned to work after three weeks' treatment. After three months, returned with "all signs of an abdominal aneurism."

*Operation.* Laparotomy; aneurism double fist size; five and one-half feet, one-half millimeter, silver-plated, copper wire passed through a needle one millimeter in diameter. After operation patient suffered several days from vomiting, but temperature never rose above 101°. Rapid recovery, patient leaving hospital eight weeks after operation feeling perfectly well. Tumor, on dismissal of patient, consisted of a hard nodule, one-half the size of original tumor, with only communicated pulsation and no bruit.

The wife of the late Dr. Morse writes that this patient lived in good health four years, doing the heaviest kind of work as stevedore. Then, after a prolonged debauch and a kick in the abdomen by a companion, he had a spell of uncontrollable vomiting, during which he died from hæmorrhage.

CASE X.—Pringle and Morris: 1887. *Medico-Chirurgical Transactions*, London, LXX, 261.

German tailor; aged 46; history syphilis. A visible, pulsating, expansile tumor of the abdomen. Signs of erosion of the vertebrae.

*Treatment.*—Rest in bed, Tufnell's diet, potassium iodid, morphia. Aneurism increased and "patient's strength at a low ebb."

*Operation.*—Laparotomy; exposure of sac; trocar and cannula introduced downward and to the left; after one foot of steel wire had been passed a kink occurred, and wire was cut off and end pushed in. Patient died fifth day from asthenia; highest temperature had been 100.6°.

*Autopsy.*—Localized recent peritonitis in operative region. Aneurism arises from posterior part of aorta and to the left, opposite the origin of the celiac axis and sup. mes. ar. Opening oval, measuring one inch vertically by five-eighths of an inch transversely. Ante-mortem clot found throughout the sac, being greater on the left side, where, by means of the galvanometer and poles of a battery, the wire was located. The wire had obviously fallen from its point of introduction and lay imbedded in this portion of the sac.

CASE XI.—White and Gould: 1887. *Medico-Chirurgical Transactions*, London, LXX, p. 277.

A smith; aged 48; denies syphilis. Swelling of right chest noticed for five months; for two months a severe cough; dark thick expectoration; pain in the swelling.

*Treatment* for six weeks by rest, restricted diet and iodid of potassium, with no results. Swelling rapidly increasing in size and threatening death by rupture.

*Operation.*—Cocaine; Southey's trocar introduced into third intercostal space at spot where pulsation seemed most superficial. After passing 9 or 10 feet of fine steel wire it broke, and a second canula was introduced and 22 feet were introduced through it. Patient became faint but did not complain of pain. Death, ninth day, after more or less constant oozing of blood-stained serum through the site of operation.

*Autopsy.*—Fusiform aneurism of ascending arch, and from this, communicating by a large opening, arose a cocoanut-sized saccu-

lar aneurism. From this arose an extrathoracic portion with no definite sac wall, but being limited by a soft, shreddy, muscular tissue, abundantly infiltrated with blood and serum.

The external portion and the sacular aneurism contained a confused mass of steel wire, in the meshes of which, and surrounding which, was a considerable quantity of firm red fibrinous clot.

The mouth of the sacculated portion entering the aorta was very large, admitting four fingers; through this had extended a loop of wire into the fusiform dilatation of the arch.

This was an unfavorable case because of its rupture before operation and advance into the softer extrathoracic tissues. The fatal termination was due to the sloughing of the tissues over the aneurism, hastened by a pad over the oozing tissues pressing through on the unyielding mass of wire beneath.

CASE XII.—Hulke: 1887. *Medico-Chirurgical Transactions*, London, LXX, p. 289.

Seaman; aged 31; heavy work; denies syphilis.

*Diagnosis*.—Aneurism of innominate and aorta.

*Treatment*.—Severe Tufnell plan.

Improved and left hospital.

Returned about five months later in a desperate condition.

*Operation* same day: Ether; 10 to 11 yards pianoforte wire introduced through a small canula. Felt better several days; aneurism decidedly firmer; on fifth day oozing began just above site of puncture from a crack in cuticle; aneurism began to enlarge; on twelfth day oozing from side of aneurism at a distance from site of puncture. Difficulty of breathing increased; died after 13 days, apparently from exhaustion.

*Autopsy*.—Aneurism of first part of subclavian. The wire, covered with a considerable layer of white fibrin, filled all parts of the sac except the upper. It was this portion which continued to expand, and from which the oozing took place.

CASE XIII.—Stevenson: 1895. *Lancet*, London, Vol. I, p. 22.

Gunner in English army; aged 25; denies syphilis. A tumor with all characteristics of an aneurism, two inches below the costal margin and three inches to left of median line; size of a large orange; movable as patient moved from side to side.

*Treatment*.—Tufnell's diet, iodid of potassium, absolute rest in bed; also at suggestion of Professor Wright, calcium chlorid and inhalation of carbon dioxid gas. Coagulability of blood considerably increased, but no change apparent in tumor after three months.

*Operation*.—Laparotomy; transverse colon and omentum pushed up; many adhesions being broken. Two yards of finest steel wire introduced, the last end being pushed through canula by blunt knitting-needle. No bleeding on withdrawal of canula; but that evening there was a severe hæmorrhage from lower end of wound, corresponding to the site of trocar puncture through the sac. This hæmorrhage reduced the condition of patient and he died 27 hours after operation and 11 hours after bleeding had ceased, probably from syncope on attempting to sit up in bed.

*Autopsy* showed sac to arise from proximal end of superior mesenteric artery and to involve the anterior wall of the aorta. "Sac completely filled by coagulum and silver wire."

CASE XIV.—Langton: 1899. *Brit. Med. Jour.*, Vol. I, p. 791.

A woman gave birth to a child three months before admission to the hospital. Since labor she had noticed an abdominal swelling; and, on admission, there was a pulsating tumor in the epigastrium, three and one-half inches in diameter, movable laterally, but not vertically, and over it was a loud systolic murmur. In April, 1898, the swelling being on the increase and the pain intense, an exploratory laparotomy was performed, and the tumor found to be an aneurism of the upper part of the abdominal aorta. A trocar and cannula were introduced and an

attempt was made to pass salmon-gut into the sac. This proving difficult, 5 feet of silver wire were passed with ease.

Careful examination a month later gave evidence of consolidation. At the time of the report, March, 1899, there was "a hard mass in the middle line much smaller than before the operation, and the thrill and bruit had disappeared. Her health was excellent."

#### ABSTRACT OF THE CASES TREATED BY PASSING ELECTRICITY THROUGH A PERMANENT WIRE. MOORE-CORRADI METHOD.

CASE I.—Buresi (Corradi): *Lo Sperimentale*, April, 1879, p. 445. See later account by Marcacci: *Giornale Internazionale delle Scienze Mediche*, 1881, p. 1109.

Man; aged 43. Large aneurism of ascending portion of arch of aorta. Considered a hopeless case because of thin wall and rapid expansion. Medical treatment of no avail. Corradi inserted a canulated needle into second intercostal space, directing the point away from the probable site of opening from the aorta. Forty-two cm. (17 inches) of No. 30 annealed wire were passed, the needle being constantly circumducted with the object of giving the wire a coil as it entered the lumen. The needle being withdrawn, the end of the wire was connected with the anode of a galvanic battery of 16 elements, tested by a voltmeter to yield 1 cc. of hydrogen gas for the first minute. Cathode to chest-wall. Current passed for 25 minutes. At the end of the first 15 minutes of its application all pulsation had disappeared except that communicated.

Operation well borne. Pain entirely gone at end of third day. Patient continued to do well for a time, but subsequently all symptoms returned and he died 3¼ months after operation. No autopsy.

CASE II.—Barwell: 1886. *British Medical Journal*, Vol. 2, page 675.

Man; aged 39; syphilis 20 years before, secondary symptoms for eight years; thoracic aneurism; a visible pulsating tumor from first to third costal cartilage on left side.

*Treatment*.—Rest and diet for seven months; at first improved, only to become worse.

*Operation*.—About ten feet of the finest steel wire through a hollow needle of ivory; this wire connected with the positive pole of a battery, the negative being applied by means of a large pad of spongio-piline to the back. A current equal to nine or ten milliamperes passed for one hour and ten minutes, the man feeling no pain or inconvenience. No change in tumor during operation, but at end of twelve hours patient appeared very much improved, the tumor more solid, the pulsation more distant.

Four days after operation a tumor appeared to right side of sternum, which the patient said had existed there two years previously. The man died a week after the operation from rupture of the new right sac into the right pleura.

*Autopsy*.—"The wide coils of wire are surrounded by thick, firm, colorless clot, which in many places binds the wire to the sac-walls, thus strengthening them and rendering rupture hardly possible wherever the wire had penetrated. This had not occurred in the secondary sac."

CASE III.—Roosevelt: 1887. *Medical News*, Vol. L, 398.

Man; aged 25. Syphilitic history. Thoracic aneurism on the right, involving the four upper ribs near the sternum. Rest and potassium iodid two weeks; tumor increased, and case became utterly hopeless.

*Operation*.—No anæsthetic; a short insulated aspirator needle into tumor; 225 feet fine (No. 00) steel piano-wire passed in; about 25 milliamperes passed for one-half hour without pain.

Next day tumor pulsated less strongly. "By the tenth day



tumor was much less painful, the pulsation visibly diminished, and he could breathe easily lying on his back or left side, which he formerly could not do." During third week he could swallow and breathe with greater ease, and the tumor felt harder. On the 21st day he began to vomit and complain of headache. On 22d day a painful dark-colored spot appeared on one toe and the man appeared bad. Death on 23d day; no autopsy.

CASE IV.—Abbe: 1887. Medical News, Vol. I, p. 397.

Man; aged 46. Thoracic aneurism filling right supraclavicular space.

*Operation.*—One hundred feet No. 1 catgut passed into sac; outer one-third of sac became harder but the remainder continued to increase. Nine days later, 150 feet of fine steel wire passed through an insulated aspirator needle; a large copper plate, covered with wet cotton, placed at back.

Current of 50 milliamperes passed one-half hour; then 100 milliamperes for same time. Then, with the negative pole connected with the wire and the positive with the plate, a current of 100 ma. was passed in the reverse direction. Patient rather exhilarated than otherwise. Tumor still pulsating at conclusion. Death 2d day from rupture of sac into trachea. No autopsy.

CASE V.—Kerr: 1889. Occidental Medical Times, January.

A Greek; aged 38; syphilis.

*Diagnosis.*—Aneurism of ascending arch.

*Treatment.*—Rest in bed, on low diet and potassium iodid for three months; no improvement.

*Operation.*—Six feet drawn silver wire introduced through a medium-sized hypodermic needle covered with shellac; positive pole connected with wire, negative pole with tin plate over epigastrium; current, strength not stated, passed for 50 minutes. Relief from pain and diminution of pulsation, but on ninth day patient complained of a pressure behind sternum; on twelfth day pulsation well marked in suprasternal notch, and on eighteenth day patient died.

*Autopsy.*—Fusiform aneurism extending from base of heart to origin of left subclavian. "The wire entered the anterior surface of the sac; and around it, as well as on the walls, a firm clot was formed."

CASE VI.—Kerr: 1889. Occidental Medical Times, January.

Man; aged 56. Duration, 10 months; had been unable to work for 3 months past. On admission a pulsating tumor found on right side of sternum, extending to right mammary line and from second to fourth intercostal space.

*Treatment.*—Rest and potassium iodid two months—no improvement; electrolysis through two needles—no improvement.

*Operation.*—Ten feet drawn silver wire inserted, using the same method as with his first case. During the half-hour of electrolysis the pulse was very small and rapid, and there was distress and dyspnoea, but no pain. For a month he had slight burning and pain over the aneurism; these disappeared and the pulsation diminished in area and force. At the end of two months the patient left the hospital, saying he "felt as well as ever."

Dr. Kerr writes me that he knew the patient to be working as a street-paver for 10 months after discharge, and then lost trace of him, although the patient promised to send for him or reenter hospital should he again be troubled.

CASE VII.—Rosenstirn: 1891. American Journal of the Medical Sciences, N. S., Vol. CI, p. 55.

Member of the victorious Harvard crew of '83; aged 25; weight 260. "He loved wine, women and song—the two former most." Consulted Dr. Rosenstirn first in 1888 with palpitation of heart and slight dyspnoea. Later a distinct pulsating tumor found occupying second and third intercostal spaces in the right parasternal line. Absolute rest in bed, low liquid diet, cautious massage of extremities, large doses of potassium iodid. Three

months gave no apparent benefit. In January, 1889, electrolysis through two needles on two different occasions; effect nil; symptoms grew worse; desperate condition.

*Operation.*—Twenty-six inches of spirally wound, moderately thick, softened silver wire passed through an explorative trocar and the end pushed entirely in. Then a current of 70 milliamperes passed through the trocar for thirty minutes. Patient bore operation remarkably well. After a few days pain began to subside, and after two weeks the breathing became easy and he had no more attacks of suffocation. In two months the pulsation entirely disappeared and patient was finally in most excellent health.

A letter from Dr. Rosenstirn says his patient now weighs about 280 lbs., is in good health, and leading an active life as captain or colonel of one of the volunteer regiments stationed on the Pacific coast.

CASE VIII.—Stewart: 1892. American Journal Medical Sciences, Vol. CIV, p. 422.

Insurance agent; aged 30; fond of wrestling. First examined in July, 1888; a small, expansile, pulsating swelling to the left of the upper lumbar vertebrae. Improved under three months' treatment by rest and potassium iodid, and went to work. In September, 1891, had been in bed two months with pain and prostration. Now a very large lumbar aneurism, having three large bosses, which in places seemed very thin. Signs of spinal-cord involvement.

*Operation.*—Two and one-half feet rather heavy silver wire (No. 23, Brown & Sharp gauge), coiled for spiral arrangement, passed through an insulated (shellac) steel needle. Current gradually increased until 70 milliamperes were reached and this strength maintained for one hour. The negative electrode was a very large felt-covered plate, which lay upon the right shoulder and scapula. Patient showed evident improvement for a few days, but pain grew worse, and on the ninth day, after thumping the aneurism with his fist, he had a gush of blood from mouth and died.

*Autopsy.*—An aneurism of immense size, filling hypochondrium and a part of the lumbar region. It had evidently arisen from the posterior and left lateral wall of the thoracic aorta and subsequently involved a portion of the abdominal aorta. The site of rupture was in the upper left portion, where the sac wall and laminated clot had been penetrated. A large sinus plowed into the lung. The highest coil of wire was two and one-half inches distant from the point of rupture. Firm clots in all portions of aneurism with soft clots of recent origin. The wire engaged in several large firm clots of so solid a texture that they were separated from the sac and wire only with some difficulty. The rupture was probably due to failure of wire to reach all parts of the large sac and consequent increase of pressure on a portion that had not yet been strengthened by fibrin formation. Stewart regrets not having used more wire.

CASE IX.—Stewart: 1896. American Journal of the Medical Sciences, Vol. CXII, p. 170. Autopsy; British Medical Journal, August, 1897, p. 387.

Man; aged 40; vagrant habits; syphilis in 1881; evidences of aortic and mitral disease; much albumin in urine. Large aneurism right chest; put on Tufnell's treatment and potassium iodid; aneurism increased in size, became very thin-walled; rupture seemed imminent. Refused interference by deligation.

*Operation.*—Conjoint use of the wire method and of galvanopuncture by means of several platinum needles connected with the same rheophore as the wire, hoping thus better to secure an extensive coagulum from wire to needles and to sac wall. Two platinum needles good caliber, insulated to within an inch of the end, first introduced toward periphery of sac. Ten feet of fine gold wire, drawn hard to No. 30 gauge, played into sac;



positive pole connected with wire; negative pole, a large clay plate, placed upon the abdomen; current gradually increased to 80 milliamperes and there kept for one hour.

Before end of session much less marked pulsation in sac; needles moved about with difficulty; procedure well borne; no pain felt at any time during operation or subsequently, and no evidence of shock.

Four weeks later, it being considered that only the lower part of the sac was filled by clot, another attempt was made to enter wire into upper portion of the sac, and this was found to be filled by coagulum.

Patient lived nearly three and one-half years after operation and died as the result of the formation of a large thrombus in the middle cerebral artery, the result of the advanced endarteritis present."

*Autopsy.*—The aneurismal sac springs directly from the root of the innominate artery; approximately the size of a fetal head at term; completely consolidated with organized coagula, in which lie the coils of wire.

CASE X. Hershey: 1896. The Therapeutic Gazette, Vol. XX, p. 590.

Man; large aneurism right chest, probably sacculated innominate aneurism.

*Treatment.*—Rest in bed, diet, barium chlorid. At end of 7 weeks symptoms all exaggerated.

*Operation.*—Two and one-half feet gold wire, hard drawn to No. 28 gauge, passed through hypodermic needle insulated with gum shellac. Usual method of galvanism with indicator kept at 70 milliamperes for an hour. "The needle, at first moving freely with each heart beat, became fixed; and instead of the soft, full, pulsating mass characteristic of an aneurism, was felt a hard resisting tumor much smaller."

Patient slept on back that night for the first time in 7 weeks. After 2 months, returned to work, and 9½ months later, at time of report, the patient was well and at work as a mining prospector.

Dr. Hershey writes me that one year after operation the symptoms began again, and the patient died 14 months after operation from rupture of the sac. No autopsy.

CASE XI.—Stewart: 1898. Phila. Med. Jour., Nov. 12.

Day laborer; aged 40; entered Episcopal Hospital because of a pulsating tumor in the upper left quadrant of the abdomen. Patient had had syphilis; possessed sclerosed arteries; urine indicative of Bright's disease.

*Diagnosis* lay between aneurism of the splenic artery and a pulsating abdominal tumor. Section disclosed what appeared to be a saciform aneurism springing from the left of the aorta at the situation of the celiac axis."

Ten feet of fine silver wire were inserted and a current of 50 ma. passed by the anode for a half-hour.

Patient died suddenly the fifth day. Examination of abdominal contents through the wound revealed a large retroperitoneal tumor almost encircling the aorta, causing a marked fusiform dilatation extending even above the diaphragm. Continuous with this fusiform widening there was a small saciform aneurism of what appeared to be the splenic artery.

The wire had been passed through a portion of the tumor into the saciform aneurism and thence into the dilated aorta. No clot was found on the wire within the aorta, and no mention is made of any wire stopping in the sacular aneurism.

Death was caused by hemorrhage into the stomach, but its origin could not be determined.

CASE XII.—Stewart: 1898. Phila. Med. Jour., Nov. 12.

A railroad engineer; aged 42 years; history of syphilis; an extremely large thoracic aneurism of the transverse and de-

scending portion of the arch. Bad aortic and mitral disease. Constant intense pain, requiring the use of large doses of morphia.

*Operation.*—Fourteen feet of spirally wound fine gold wire were introduced at the more prominent part of the aneurism through two insulated needles. The terminal ends of the wire from these were connected with the anode and the current rather rapidly raised to 80 ma.; the electrolysis occupying 1 hour and 20 minutes. After the operation "the aneurismal swelling was decidedly less prominent, much less to-and-fro pulsation; bruit over mass not so apparent, and much less pain complained of." For periods the pain disappeared altogether. Three months after operation explorations were made with a large 3-inch needle in four different situations where the tumor seemed softest. The needle was inserted to its hilt and in but one place was blood reached. An attempt to insert wire here was baffled by the clot beyond, as but 2 or 3 inches could be passed.

The patient died suddenly eight and one-half months after operation. No autopsy.

"The aneurism in this case was much too large and the cardiac condition much too unfavorable" for one to expect a cure to result. "That the patient's life was undoubtedly prolonged and his condition made much more comfortable was unquestionable." Dr. Stewart regrets not having used 20 instead of 14 feet at the first operation.

CASE XIII.—Noble: 1898. The Philadelphia Medical Journal, Vol. I, p. 1203.

An Englishman; aged 37 years; alcoholic; history of syphilis. *Examination.*—A pulsating tumor, the size of a large fetal head, midway between the ensiform cartilage and the umbilicus. Great pain, requiring much morphia.

Rest in bed, as nourishing diet as could be taken with his difficulty in retaining food, potassium iodid, opium. Condition grew rapidly worse and at the end of two weeks operation was decided upon.

*Operation* (July 14, 1897).—Laparotomy; 8½ feet of hard-drawn, No. 30 gold wire passed through a needle insulated with celluloid, and tipped with gold.

Current slowly increased until 70 milliamperes was reached, and here maintained for 6 minutes. In all, about 35 minutes of electrolysis. Patient showed marked signs of failure and had to be hastened off the table. No pain after the second day and improvement was rapid. Pulsation about stomach disappeared and patient was able to retain nourishment. Discharged in 6 weeks, with the mass lessened to the size of an orange. Transmitted pulsation and a slight thrill could be felt. Patient died 8 months later with acute dysentery, intercurrent with great debility, due to a tumor of lower jaw. He had had no further symptoms of aneurism. No autopsy.

CASE XIV.—Halsted's case. See report below (Case I).

CASE XV.—H. A. Hare: Therapeutic Gazette, May, 1898.

Man; aged 46 years; history of syphilis; on admission, suffering from pain, dyspnea and cardiac disturbances; later he developed brassy cough, and sputum became tinged with bright blood.

From the signs and symptoms a diagnosis was made of aneurism of the terminal portion of the transverse and the beginning of the descending aorta.

Patient did not improve under treatment by rest, potassium iodid and aconite.

*Operation* (March 3, 1898).—Nine feet spirally wound fine gold wire introduced through an insulated needle, and a positive current passed for 1 hour, increasing rapidly from a few to 70 ma.

The operation well borne. Signs of consolidation somewhat apparent towards the end of the electrical session, in that there was less excursion of the mass and of the needle; and the needle

acquired the sensation of engaging a more solid mass. The aneurismal bruit, very marked in the second left intercostal space before operation, had much diminished the day following the operation, and in 48 hours had entirely disappeared. The expansile pulsation and the thrill had greatly lessened.

Five weeks later: "The expansile pulsation and the thrill have entirely disappeared and the impulse in the second left intercostal space feels as the apex beat would feel if displaced. The bruit has entirely disappeared and only a double aortic murmur is to be heard. Blood-spitting has not occurred. Cough has ceased."

The patient was in comparatively good health for 6 months after the operation, when symptoms began indicating the extension of the aneurism posteriorly and to the left. He died in October, 7 months after operation, from symptoms of pressure on the trachea. No autopsy.

CASE XVI.—Finney's first case. See report below (Case II).

CASE XVII.—Reeve: 1899. *Annals of Surgery*, Phila., Vol. XXX, p. 704.

A negro, aged 49 years, who had been ill for 2 years, was admitted to the hospital complaining of abdominal pain and presenting a large dome-shaped swelling in the upper umbilical region. This tumor had been discovered 9 months previously, and two months before admission it was diagnosed as an aortic aneurism. Pain was intense, the patient being kept continuously under the influence of morphia.

Under Schleich's anesthesia, celiotomy was performed and 7 feet of silver plated, soft, copper wire, .016 inch in diameter, were introduced before a hindrance occurred. The wire had no previous preparation to insure its coiling in the sac. The positive galvanic pole was attached and the current gradually increased to 80 ma., where it was kept for 50 minutes. Not much suffering caused by the current except at one time, when for a few moments it was increased to 110 ma. "After 50 minutes, syncope was threatened, and the séance was discontinued. Distinct firmness of the tumor had occurred, as well as a disappearance of the expansile pulsation."

The patient lived 24 hours.

An extract from the pathologist's report says: "An aneurism of the abdominal aorta, two inches above its bifurcation. A wire, irregularly twisted, occupied the center of the sac, surrounded by and mixed with old and recent clot; one end, together with a double loop of wire, passed up the aorta, the looped part reaching about ten inches, and the single strand quite up to the aortic valves of the heart, where it left a spot of ecchymosis. The aneurism was distinctly sacculated; the opening from the aorta into the sac being not over one inch in diameter."

CASE XVIII.—Corson: 1899. *The Phila. Med. Jour.*, Vol. III, p. 511.

Man; aged 31 years; excessive user of alcoholics; no definite history of syphilis. The patient complained of a hoarse cough and a severe pain under the left shoulder blade. His pulse was 110, and he was nervous and excited. Examination revealed a large pulsating tumor on the left side above the clavicle.

The trocar and cannula were inserted through the sternocleidomastoid muscle, and a drawn silver wire, six feet in length, was introduced. Eight cells of a dry-cell battery were used for two hours, the strength of current being regulated according to the patient's comfort. After a half-hour the pulsation began to grow less, and at the end of two hours the hardness of the tumor had much increased. Patient did well until the morning of the second day, when the cough and dyspnea grew worse and patient died.

Autopsy revealed, as near as one can judge from the description, an aneurismal dilatation of the arch just above the heart, and from this an immense sacular dilatation, probably in the

course of one of the large vessels on the left. In this latter sac was "the wire coiled closely in contact with its walls." We infer that pure silver wire was used, and nothing is said of the thoroughness with which it was drawn. Pure silver, only slightly drawn, and with no precautions to insure its coiling, would be almost certain to take the faulty position described.

CASE XIX.—Stewart's fifth case, not yet reported.

A traveling salesman of Baltimore, with a large thoracic aneurism had refused operation for some weeks, until his condition became very desperate. His life being threatened from dyspnea, he went to Dr. D. D. Stewart, of Philadelphia, who wired his aneurism on three different occasions with very good result each time. But, unfortunately, the relief was temporary and the aneurism continued to extend until the patient's death from rupture about nine months, I believe, after the first operation.

CASE XX. Hare: 1900. *Therapeutic Gazette*, Phila., Jan. 15, p. 9.

A merchant, aged 48 years, with no history of syphilis. A rapidly growing aneurism eroding the second, third and fourth ribs and the costal cartilages to the left of the sternum. First noticed one year previously. For 7 months the patient had been in bed and had lost 60 pounds in weight. The most prominent part of the growth was elevated about two and a half inches above the surface of the chest, but there were three spots in which the blood was evidently near the surface, and in which expansile pulsation was marked."

Operation (April 18, 1899).—The needle inserted into the apex of the growth and ten feet of gold wire introduced, and a current passed for one hour and thirty minutes, beginning at 10 ma. and gradually increased to 100 ma.

Marked improvement in the patient's condition, allowing him to sit up a portion of each day and to walk a little. The aneurism shrank and lost its expansile character except at one point. Because of this point of pulsation, Dr. Hare operated one month later in a similar manner, but this time he passed a second ten feet and kept the patient under the electrolysis for a second hour.

The aneurism persisted, and after two or three months gave evidence of extension to the left. Dr. Hare contemplated a third operation, when the patient died from rupture of the sac, on November 30. No autopsy. Dr. Hare says: "I have no doubt that his life was much prolonged in view of the thin sac wall at three points when he was first seen, all of which were threatening rupture at any moment."

CASE XXI.—Finney's second case. See report below (Case III).

CASE XXII. Finney's third case. See report below (Case IV).

CASE XXIII.—Finney's fourth case. See report below (Case V).

Five cases have been operated upon at the Johns Hopkins Hospital, a report of which shows an interesting development of technique. The records of the first two cases, which were fatal, and upon which autopsy was held, and of the last case, are particularly valuable in showing the extreme difficulty in diagnosis of the actual condition, even with celiotomy. Appreciation of these difficulties will aid in making the prognosis sufficiently grave when laying the question of operation before the patient and his friends.

CASE I (Case XIV of entire series).—W. T. G., a printer, aged 27 years, was admitted, October 26, 1897, to the service of Dr. Osler. Dr. Norton, of Washington, sent the patient with the diagnosis of abdominal aneurism.

*History.* Since a boy he has always been accustomed to holding type in his mouth. He has carried heavy "forms" of type resting against his abdomen, and has lifted heavy weights in the gymnasium. He has had several attacks of gonorrhœa, and about seven years ago an attack of acute arthritic rheumatism which he thinks was synchronous with urethritis. No definite history of syphilis. He has been a pretty heavy drinker of alcohol since a boy.

His present trouble dates since May or June of this year, when he began having a "dull dragged out feeling" and occasionally sharp pains across the abdomen, which caused him to lie doubled across his printer's stool for the pressure benefit. At this time he often vomited after eating, but has not vomited for the past two months.

The pain and weakness have increased since May and he has lost about forty pounds in weight. During the past month he has been obliged to sleep on the left side or in the erect posture, because of pain when in any other position. Pain is referred to the pelvic region, at times shooting into scrotum, at times extending even to the knees. In walking the street a sudden jar gives great pain. He walks slightly bent forward to avoid pain. He first noticed pulsation in the abdomen one month ago.

On physical examination he is found to have moderately sclerosed arteries; a markedly accentuated second aortic sound; no blue line on the gums or other evidence of plumbism.

On inspection of the abdomen a diffuse pulsation over the whole upper abdominal region, most marked in the left epigastrium, is seen. This region is prominent, and the left costal margin over the sixth and seventh cartilages is bulged slightly forwards. The pulsation is felt to be limited to the upper half of the abdominal aorta, over which a globular expansile mass the size of a very large orange can be outlined. A purring systolic and diastolic thrill is felt over the mass. Percussion gives dullness everywhere over the mass, but later, during observation, stomach tympany is found on percussion over its lower quadrant. On auscultation a loud double murmur, a systolic, loud, harsh, and short, a diastolic, fainter, prolonged, and almost musical in character, is heard. In the back a soft blowing systolic murmur is heard over an area to the right of the vertebrae extending from the eleventh dorsal to the first lumbar. The knee-kick is somewhat exaggerated.

The patient was irritable and incapable of restraint. He was kept on a moderately low diet and as quiet as possible on anodynes; but it was evident from the first that the aneurism was increasing in size and would, in all probability, soon prove fatal.

After having the possibilities of the operation presented, he begged that the attempt at cure might be made. He was transferred to the service of Dr. Halsted and, on November 21, operated upon.

A median incision was made from ensiform to umbilicus, exposing a pulsating mass in the epigastrium, seemingly about fist-size, lying behind the lesser peritoneal cavity. This could be reached only through the lesser omentum by pulling down the stomach and approaching the sac above the lesser curvature. An area 1.5 x 2 cm. was laid bare over the sac wall by blunt dissection through the posterior layer of the lesser peritoneal cavity and its underlying subserous fatty layer. The wall of the sac seemed very thin at this point. A distinct expansile pulsation and a thrill were perceptible to the fingers. A hypodermic needle was inserted to test the thickness of wall. A long aspirator needle of small caliber was inserted and an attempt made to pass a No. 25 wire (No. 4 piano-gauge). This was of pure silver and withdrawn, and had been rolled on a wood reel and boiled. After passing a few inches the wire kinked and both needle and wire were withdrawn. Bleeding followed but was easily controlled by pressure of a finger.

The needle was oiled and again inserted, and about 17 inches of No. 25 wire introduced, when it again kinked. The current

was passed through this for 12 minutes. The needle was withdrawn and the wire, being cut off near the sac, was pushed under the surface by catching it in the point of an aspirator needle.

A third and larger aspirator needle was now inserted and 38 inches of No. 25 wire (No. 4 piano) were passed through it with ease. Considerable bleeding took place from the lumen of the large needle, so it was withdrawn and the wire cut about a foot from the sac. Hemorrhage was controlled by slight pressure of a finger beside the wire at its site of entry.

The galvanic current was then passed, the anode being connected with the end of the wire, and the kathode with a large metal plate, wrapped with a towel and placed under the back. The electrolytic action was continued for 1 hour and 25 minutes, varying in strength from 30 to 100 milliamperes. At its height, the current caused contracture of the muscles of the trunk when there was any change made in its strength by the rheostat. No appreciable change took place in the pulsation of the aneurism during the process. The wire was cut off close to the sac and the posterior peritoneum closed over the site of puncture with fine silk sutures.

There seemed to be no other abnormality of the patient's abdominal viscera. His pulse varied between 90 and 120 during the operation.

He lived about 40 hours after operation and died with symptoms of sudden internal hemorrhage.

*Autopsy Notes.*—Abdominal wound, 16 cm. long, firmly glued together. A few delicate adhesions of omentum to abdominal wall beneath the incision. The aneurismal sac is collapsed; it lies behind the lesser peritoneal cavity to the left of the vertebral column, extending slightly beyond the right margin of same. It extends from the diaphragm to which it is firmly adherent to the renal vein, which runs transversely over its lower anterior edge.

It pushes the spleen to the left and touches the upper anterior surface of the left kidney. The pancreas lies over its lower third.

The left pleural cavity is found to contain an immense blood-clot, forming a complete mould of the cavity and weighing 1170 grams. In addition, 960 cc. of fluid blood are removed. The diaphragm is seen to bulge considerably into the pleural cavity, and at the summit of the dome is a ragged hemorrhagic area, the site of rupture. A little to one side of the perforation, which scarcely admits the tip of the little finger, lies a loop of the wire.

On opening the aneurism and the aorta the aneurismal opening is found to have a vertical diameter of 8.5 cm., while that of the sac is but 10 cm.

The aorta in this region presents a fusiform dilatation, its right border projecting slightly beyond the right margin of vertebral column. The anterior wall of this dilated portion of aorta is very rough and atheromatous, and peculiarly elastic. The posterior wall is thinned and so adherent to the vertebra that these have to be chiseled away in order to remove the aorta and sac.

The aorta is considerably narrowed below the sac, its circumference above and below the aneurism being respectively 4.8 cm. and 3.4 cm. The chief abdominal vessels arise from the lower left portion of the sac; the celiac axis and superior mesenteric coming off within the sac, while the renals spring from the dilated aorta just at the mouth of the sac.

The wall of the aneurismal sac is everywhere thin; being thickest anteriorly and to the left, where the retroperitoneal tissues have assisted in strengthening it, and thinnest superiorly where it bulged toward the pleural cavity. Its inner surface is rough and covered with loose coagulum, there being no evidence of uniform lamellated deposit of fibrin.

The walls are held apart by 4 or 5 coils of silver wire, which



lie peripherally and near together, forming an ellipse whose plane is anterior-posterior with reference to the body. These coils are covered by loose coagulum, which readily becomes detached on manipulation.

Death, from rupture of the very large, tense and thin-walled sac, with enormous mouth, could not have been long delayed; but it is probable that it was hastened by the wire working against the sac wall.

Considering the position of origin of the celiac and superior mesenteric vessels from the wall of the sac, there can be no doubt that the patient's death would have been even more precipitous had there been a formation of an obliterating clot during the operation.

**CASE II (Case XVI).—R. E.,** book-keeper, aged 25 years, admitted to the service of Dr. Osler, July 29, 1898, complaining of an abdominal tumor with pain.

*Family history good.*

*Personal history.*—Childhood's diseases, no scarlet or typhoid fever, no diphtheria or lung trouble. Malaria for several summers as a boy. No rheumatism. Urethritis at 19 for 2 or 3 months; no sequelæ. Bubo at 21, on both sides; knows of no cause, but at the same time had an herpetic eruption on penis. Had not been exposed in venery for 2 or 3 months before this. Alcoholics very moderately. No tobacco. No heavy work. No traumatism.

*Present illness.*—In October, 1897, the patient had a severe pain of a sharp, steady character just below the umbilicus. This lasted one week, keeping him awake at night. He had no more trouble until March, four months ago, when he noticed tenderness on the right side just below the costal margin and in the flank. In a few days such severe pain set in that opiates were resorted to. Gradually his skin became yellow and his urine very dark. The stools were never noticed to be clay-colored. The jaundice was of five weeks' duration. The pain has gradually increased since March, never being of a throbbing character.

Physician's examination in April was negative. On July 20, he was examined under anæsthesia and a diagnosis made of abdominal aneurism.

On admission, careful physical examination was negative, except for sclerosed arteries and the abdominal tumor.

In the epigastrium was a marked pulsation. On palpation a marked shock and distinct purring thrill were felt with each systole. One could outline a globular mass about as large as a medium-sized orange, and from this got expansile pulsation. On auscultation, a loud, amphoric, systolic murmur was heard, limited to the tumor area. No diastolic murmur. Second sound very faint. No murmur heard at the back.

*Operation.* During one month of treatment on absolute rest, restricted diet, and iodid of potassium, the aneurism continued to enlarge and the pain to increase.

On August 27, Dr. Finney performed the Moore-Corradi operation. Under ether a median incision was made from ensiform to umbilicus, exposing the lower border of liver and upper border of stomach. Between these lay the sac almost completely hidden by a flattened-out pancreas.

The sac seemed globular, about 7 cm. in diameter, and apparently extended around the aorta, resting on the transverse processes of the vertebræ. The pancreas was separated with difficulty and finally had to be divided in order to expose the sac. Beneath its upper border and flattened out across the sac was the splenic vein, about 1 cm. in breadth. Puncture was made in the upper edge of the sac just above this vein, the needle pointing downward and as nearly parallel with the aorta as convenient. Five feet of silver wire were passed through this fine insulated aspirator needle. The wire was alloyed with 75/1000 of copper and drawn from No. 8 to No. 27. After being

smoothly wound on an ordinary spool, it was boiled for 15 minutes for sterilization and to give it a good spring following the swelling of the wooden spool. The wire was passed without particular difficulty by grasping it between the thumb and first finger and passing very short portions at a time. Slight oozing through the needle made the fingers very slippery, and they had to be repeatedly rubbed over an alcohol sponge.

The galvanic current was begun at 30 ma. and increased 10 ma. each 5 minutes until 70 ma. was reached, where the current was kept one hour.

After a half-hour the thrill, very marked at the beginning, had disappeared. The expansile pulsation had decreased but seemed to increase with each addition of fresh ether and resultant stimulation of the heart. At the end of this electrical session there was no thrill; no expansile pulsation could be determined; the sac was firm and decidedly smaller, as could be seen by the manner in which the splenic vein, before flattened, now stood out on the sac as a rounded vessel. After closing the abdomen nothing but a communicated pulsation, as of a solid tumor lying over the aorta, could be made out.

The success of the operation seemed assured; but, from his recovery from ether, the patient complained of excruciating pain, which increased until, within a few days, morphia was being given in  $\frac{1}{4}$ -gr. doses every 2 to 4 hours.

His temperature on the day following operation reached 102.5°, and on the third day 103.7°. Careful examination of the wound revealed nothing, although we had feared infection of the tissues made necrotic about the needle from the electrical current, and over this area in the mutilated and much ligated pancreas.

We decided that this temperature must be due to the sloughing tissues over the back; for the metal plate, which had been wrapped with a towel repeatedly moistened, had caused an unlooked-for necrosis of the skin. But on the 7th day pus was found in the upper half of the wound, apparently involving only the subcutaneous and muscular layers of the abdominal wall. The temperature lowered somewhat but remained about 100° F. until the 14th day, when it again went up, reaching 102.8° F. on the 17th day.

For the first four days no expansile pulsation could be made out, but on the fifth day it was distinct, and the sac from this time seemed to increase in size. On the 16th day nausea began, and from this time the patient was in extreme discomfort. On the 19th day there was bleeding of about 300 cc. of bright-red blood from the upper end of the granulating wound. The patient became very weak and pale, and it was evident that he was having internal hæmorrhage. He died on the 20th day, 7 hours after the hæmorrhage through the external wound.

*Autopsy* (No. 1141). The lower end of the abdominal wound healed per primam; the upper end separated and granulating. On opening the abdomen there was found a sinus, filled with blood-clot, leading from this granulating wound down to the sac at the site of puncture. Local peritonitis existed about the wound. The lungs were normal. The heart presented slight thickening along the free margins of the tricuspid and mitral valves. The aorta beyond the valves showed well-marked nodular, and in places diffuse arterio-sclerosis. The patches were a trifle raised and of yellowish-white color. This condition extended into the abdominal aorta.

In the upper portion of the abdomen, partially covered by the pyloric end of a distended stomach, the beginning of the duodenum, and the right lobe of the liver, was a firm globular tumor mass. Flattened out over this and almost completely covering its anterior aspect, was the pancreas. The splenic vein ran across the tumor near its upper border and was covered by the pancreas. Just above the vein was the sinus of blood-clot before mentioned.

At the upper border of the tumor the celiac axis could be dissected free with its three branches.

On opening the aorta by cutting along its posterior wall, an opening  $1\frac{1}{2} \times 1\frac{1}{2}$  cm. in diameter could be seen on the anterior wall leading into the aneurism. This was evidently the greatly dilated orifice of the superior mesenteric artery, of which artery the aneurism was a dilatation. One centimeter above this opening was the orifice of the celiac axis. The inferior mesenteric arose  $3\frac{1}{4}$  cm. below.

The renal arteries, one on either side, took origin on the lower margin of the opening.

Near each renal orifice, immediately on the margin of the aneurismal orifice, was a blackened slit-like sulcus in the arterial coatings. Although there was no wire in the mouth of the aneurism at time of autopsy, it appeared as though one loop had swung across the mouth with its convex side in the aorta, thus burning the margin as described. (From this, as well as from experiments upon free blood and upon dogs, we conclude that a current of 50 ma. is dangerous.)

Looking into the aneurism through its comparatively small orifice, one could see numerous segments of coiled wire immediately about the mouth of the sac, the greater portion of each coil being embedded in a solid ante-mortem clot, which apparently almost filled the sac. Further examination was postponed until the specimen could be hardened.

The marked dilatation of the stomach was apparently due to pressure on its pyloric end as it crossed the sac. The bile-ducts were incorporated in the misplaced tissues to the right of the sac, and this suggests pressure as the cause of jaundice in the early history of the patient's suffering. The duodenum was adherent to the sac throughout its whole length. The duodenum, the jejunum, and the upper portion of the ileum were of a dark chocolate color, and on being opened were found to contain considerable bloody fluid. Their mucosa was of the same chocolate color, but seemed otherwise normal, except at one portion of the adherent duodenum.

At about the transverse portion of the duodenum there was an irregular area measuring about  $4\frac{1}{2} \times 6\frac{1}{2}$  cm., over which the mucosa was exceedingly hemorrhagic and partially necrotic. Just in this locality were found, in addition to the bloody fluid, several large fresh clots. No definite opening into the aneurism could be found, and our conclusion was that very rapid oozing had taken place through the greatly thinned walls of the adherent sac and bowel.

The large intestine was normal in appearance.

The pancreas over the tumor showed no trace of having been cut in two. There were a few small white areas of necrosis over its surface.

The spleen was considerably enlarged but otherwise normal in appearance. The liver was rather pale, and on section has a fatty appearance. The kidneys showed macroscopical evidences of parenchymatous degeneration.

*The Aneurism.* On cutting through the aneurism dorsoventrally (see photograph) one gets the impression that we are dealing with a *false* aneurism. Immediately about the aortic opening is the remainder of the dilated lumen, which, in the contracted condition of the sac, is a cavity about 1 cm. in diameter.

The wall of the aneurism may, for convenience of description, be divided into two portions—the ante-operative and the post-operative. Each of these averages about 2 cm. in thickness.

The ante-operative portion consists macroscopically of two layers: an outer, light-colored, fibrinous-looking layer (see cut (a)), averaging  $\frac{1}{2}$  cm. in thickness, which merges into the inner layer (b),  $1\frac{1}{2}$  cm. thick, and dark-red, appearing like an old firm clot.

Near the aorta the greatly hypertrophic superior mesenteric wall can be traced for a short distance until it is lost in the looser and thicker portion described above. The wall is rein-

forced near the aorta by the mesenteric lymph glands; on the inferior border, by the adherent duodenum; and over the anterior and superior border by the flattened pancreas.

Microscopically, as macroscopically, the hypertrophied wall of the superior mesenteric can be followed but a short distance from the aorta. Microscopically the muscular wall terminates rather abruptly and its elements cannot again be identified to a certainty, although there are sweeps of fibers with long, delicate nuclei scattered throughout the wall, which cannot always be identified as sympathetic nerve elements.

The peripheral light-colored portion of the wall shows fibrous tissue interspersed with such elements as one would expect to find in the wall of an expanding sac in this region. Areas of fat usually arranged in layers; and in portions of the wall the ganglia and nerve bundles of the sympathetic system are conspicuous. Lymphatic glands and vessels are seen; and, in the localities mentioned above, tissues of the duodenum and pancreas.

The inner red layer of the ante-operative portion consists of the same variety of tissues as the outer, together with a great admixture of blood elements. The picture is one of dissection of the wall by the force of the blood stream. The strands of fibrous tissue are often in a state of hyaline degeneration, probably due to their separation from a good blood supply. The capillaries of this region, although not numerous, possess cells with swollen nuclei and are rather conspicuous; but Professor Welch, who kindly examined some of the sections, classes them with the displaced tissues rather than products of an attempt at organization, it being a characteristic of aneurism clots not to organize.

The post-operative portion of the aneurismal wall (c) consists of an ante-mortem blood-clot, in the center of which can be seen the ends of the wire cut across on sectioning the aneurism. The position of the wire in the former lumen of the sac and its relation to this solid blood-clot shows the efficacy of the method, had the case been one anatomically favorable.

On making a lateral section from the first median incision and extending towards the duodenum, we find that the outer fibrous-like wall is entirely wanting at the point where the oozing took place into the duodenum, and the blood-clot within the aneurism lies in immediate contact with the blackened necrotic duodenal wall. The lumen makes in towards the duodenum at this point, but there is 2 cm. of ante-mortem clot separating the lumen of the sac from that of the duodenum. The process of fatal bleeding must have been an ooze, but the giving way of the necrotic duodenal wall was imminent.

CASE III (Case XXI).—J. T., a sea captain, aged 51 years, was admitted to the service of Dr. Osler on April 24, 1899, complaining of pain in the right chest.

His family history was good. His personal history was negative, except for very hard work at sea until within a few years.

His pain began 7 months before admission and had gradually increased. Dyspnoea began in February, 1899.

On physical examination dilated veins were seen over the whole chest and abdomen, being most prominent on the right. The whole sternum was lifted with each systole, while to the right, between the second and third ribs, could be localized an area of maximum impulse. Here a systolic murmur could be heard and a diastolic shock felt. Expansile pulsation was pronounced. The heart was negative. The right lung on percussion gave a dull note throughout the right front and in the axilla, and distinct impairment of resonance existed in the right interscapular region.

The patient suffered great pain over the entire right chest and toward the right shoulder.

His condition grew worse and, on April 25, gelatin injections were begun, the patient receiving 250 cc. of a 1 per cent solution



subcutaneously. After 9 injections of a 1 per cent solution the strength was doubled. Between April 25 and July 27, 15 injections were given, with the result of lessening his pain and reducing the force of his pulsation.

On August 11, Dr. Finney operated, passing into the sac 10 feet of the silver wire alloyed with copper, drawn, and prepared as described in the above report on Dr. Finney's first case. The galvanic current was applied for 1 hour at 10 ma., and for 15 minutes at 20 ma.

Cocaine was injected over the point to be punctured. After loading the needle with wire, the skin was drawn to one side and the needle inserted pointed toward the right portion of the sac. After passing through the skin and about 2 cm. of subcutaneous tissue and muscle, a few drops of sanguinous serum came through the needle. After this the needle was felt engaged in a solid substance for about 2 cm., when it suddenly broke through and a stream of arterial blood spurted with each heart-beat. The wire was easily passed within 5 minutes and the end attached to the positive pole of the battery. Throughout the session the patient felt a slight sticking and burning within the chest, and for the first 20 minutes a sensation as of something moving from side to side. After 40 minutes a current of 20 ma. was tried, when the burning sensation increased. The current was immediately reduced to 10 ma. After an hour the burning sensation ceased and the current was increased to 20 ma. for 15 minutes, causing no sensation to the patient. On withdrawal of the needle a slight flow of blood through the puncture wound was readily controlled by a few moments' pressure with a gauze sponge. Wound dressed with silver foil and adhesive strapping. The pulse, usually about 100 to the minute, beat at 110 to 112 during the operation.

The patient's condition, which was not bad for a week before the operation, seemed to change very little after the operation. On the third day he stated that he could no longer feel a pulsation while lying on his right side, and during the previous night he noticed for the first time that the pulsation was not so strong when lying on his back.

After a week the pulsation was as marked as before the operation, and seemed shifted somewhat to the left of the original site. His pain began again, and on the twelfth day the gelatin injections were again begun.

The patient was dismissed September 22, having had 16 gelatin injections after his operation. His condition was much improved, the pain having ceased and the wall of the sac manifestly thicker. The effect of the wire in this case seemed to be a partial filling of the large sac, causing extension toward the left. There can be no doubt that the gelatin injections were very beneficial in this case.

Patient returned September 30 because of shortness of breath on the slightest exertion, he having had no pain during the week at home.

On October 16 the patient went home, after several gelatin injections, his condition being about the same. He recovered sufficiently to again take up active work in the refitting of a dismantled ship, and whenever seen he always claimed to be perfectly well. He sailed as captain, and on the arrival of his ship at Bahia, Brazil, a cablegram was received at Baltimore, announcing his death and burial at sea on February 14, 1900. It is highly probable that death was due either directly or indirectly to his aneurism.

CASE IV (Case XXII).—J. F. G., a steam-shovel tender, aged 39 years, was admitted, October 9, 1899, to the service of Dr. Osler, complaining of pain in the chest, a dry hacking cough, and shortness of breath. His family history was negative. His personal history included gonorrhoea and possibly syphilis. He had been a heavy eater and moderate user of alcohol and

tobacco. Until within a few years he had been subject to heavy work and much exposure.

His present illness began about 18 months ago with sharp spasmodic pains in the chest, lasting 15 to 20 minutes. These attacks were almost daily and often occurred several times during a day. At times, during the early history of his trouble, he had attacks of suffocation and feeling as though about to die. The attacks of pain increased in frequency, and for the past 5 months the pain has been continuous.

About 5 months ago bulging was noticed over the painful area on the right side of the chest; and, a skiagraph being taken, his trouble was pronounced aneurism.

On admission, the patient was obliged to keep a half-sitting, half-reclining posture, and suffered a varying degree of cyanosis and dyspnoea. His pupils were equal and reacted to light and accommodation. The voice was husky and he was subject to a dry hacking cough. The pulse was slightly irregular and distinctly collapsing, there being no appreciable difference in time of the radials. No trachealugging.

The thorax was less expansile on the right side. On the right side, extending from the right mammary line to the median line and from the second rib to the costal margin, there was an area of bulging and pulsation. At the right sternal border in the fifth interspace there was a small area of unusual prominence, excessively tender to the touch and presenting a pulsation of maximum intensity. Here the pulsation was vigorous, expansile and close to the fingers. A diastolic shock could be felt and a diastolic murmur heard over this area.

The heart was somewhat displaced downward and to the left. A soft diastolic murmur was audible at the apex and over the aortic area. The other sounds were clear. The second pulmonary was accentuated.

The liver extended 7 cm. below the costal margin in the mammary line. There was well-marked movable dullness on the right side and a friction rub in the interseapular region.

From the time of admission the pulsation and prominence of the area in the fifth interspace continued to increase. The patient suffered frequent attacks of shortness of breath and cyanosis. During the first three weeks the right pleural cavity was aspirated three times, a half-liter or more of a clear, serous fluid, slightly blood-tinged, being withdrawn each time. A diagnosis was made of aortic aneurism, probably springing from the ascending arch near the heart, possibly coming from the descending thoracic portion.

On October 27, Dr. Finney operated, passing 10 feet of silver wire (alloyed with copper, drawn, and prepared as described in Dr. Finney's first case), and galvanizing this with 10 ma. for 1 hour. The excitement incident to the preparation for operation resulted in a marked attack of dyspnoea, and amylnitrite was used for inhalation. The patient was allowed to keep the upright position in his wheel-chair. A fine aspirator needle loaded with wire was introduced in a direction downward and to the right.

It was our intention to introduce a second needle and play in a second 10 feet of wire, but just as the first spool was exhausted the wire offered decided resistance and the patient said he could feel a grating sensation within. We took these two circumstances as evidence that enough wire was passed.

The patient volunteered the information that he could feel a 5-ma. current, and after five minutes that he felt the change from 5 to 7 ma., and again the change from 7 to 10 ma. During the hour at 10 ma. the patient had occasional slight burning or pricking sensations within his thorax; and the metal plate wrapped with a wet towel had to be changed once because of the burning sensation at the back.

At the close of the operation the expansile character of the pulsation had disappeared, while the heaving was still present.

The patient slept during most of the afternoon following



operation, and for 15 days the condition of his aneurism improved markedly. His general condition was kept at a low ebb because of the repeated filling of his right pleural cavity, which was aspirated every few days up to the time of death.

On November 15, Dr. Osler noted that the tumor was increasing in size, and on November 20 rupture seemed so imminent that Dr. Finney again wired the sac, this time passing 11 feet of wire and galvanizing as before. Again the improvement was decided but only temporary.

The patient was debilitated the third time on December 8 (11 feet being passed), and on the 29th an incision was made through the thinned and necrosed skin for the drainage of a large collection of sanguino-purulent material which had appeared in the extra thoracic tissues over the site of the aneurism.

The aneurism was now deep-seated and the symptoms of increasing shortness of breath, hæmoptysis, and venous engorgement of the head region indicated an extension backward. The patient had very little pain from the time of admission and anodynes were given, more for sleeplessness.

On January 14, 1900, about 11 weeks after the first wiring, the patient died, with symptoms of pressure upon the trachea. Autopsy was refused.

CASE V (Case XXIII). M. P., a sewing-machine agent, aged 30 years, was first admitted to Dr. Osler's service on October 31, 1899, complaining with what his physician had called "kidney and stomach trouble."

His family history and personal history were excellent, containing nothing to arouse a suspicion of arterial disease. His present illness began in March, 1899, with the gradual onset of intermittent pains of a burning and gnawing character located in the stomach region. These pains seemed to have no association with the taking of food. Within a month his suffering became so intense that he was forced to bed, where he remained for 3 months, requiring the continued use of morphia injections.

The pain was of a boring character, seemed central in the epigastric region, and radiated in every direction, being especially severe in the back and often shooting into the scrotum. During this 3 months he had some nausea and suffered 6 attacks of vomiting, during one of which he thought he would die. His appetite and general condition were good. He lost some weight. His bowels required the constant use of laxatives.

In July he became enough improved to leave his bed for a portion of each day, but the slightest exertion increased his pain.

In this condition he entered The Johns Hopkins Hospital and remained for 7 weeks in November.

Physical examination revealed nothing of moment except the condition of the abdomen. This was fairly normal in appearance; the costal grooves, however, being slightly less marked than usual. The iliac grooves and lumbar lines were equal and symmetrical on the two sides. Both hypochondriac regions were pigmented as a result of blisters. The epigastric region was slightly full and showed marked visible pulsation. Here there was extreme sensitiveness to pressure, with distinct resistance on deep palpation. No definite expansile pulsation could be made out at the first examination. On percussion there was dull tympany over the pulsating area. No thrill could be felt. There was a very faint systolic bruit. With the patient in the knee-elbow position, no pulsation could be felt except on deep palpation. Pulsation seemed equal in the femorals. In the back there was no bulging on either side of the spinal column, no pulsation, no bruit. Six days after admission, Dr. Osler noted that with deep palpation a definite expansile pulsation could be determined, and with deep pressure on the left side the sac could be felt.

During his 7 weeks in the hospital, the patient suffered severe pains across the upper abdomen, extending especially along the

right costal margin. This pain was often relieved by pressure from without, or by the patient lying on his left side with his head lowered.

After 2 months at home, the patient re-entered the hospital, January 14, 1900, having decided to undergo the operation advised. He had lost 6 pounds in weight since leaving the hospital. The pains had increased in his lumbar region, and for 3 weeks past he had experienced a burning sensation in his knees and ankles.

Operation (January 26, 1900; Dr. Finney).—Celiotomy; passage of 8 or 9 feet of highly drawn sterling silver wire; galvanism for one hour at 10 ma.

The conditions found in Case II were almost exactly duplicated in this case. The pulsating mass was covered over its lower portion by the stomach, over its upper portion by the pancreas, and the large splenic vein traversed its convex surface. The procedure was the same as in Case II, except that section of the very hemorrhagic pancreas was avoided by drawing the liver to the right and making the puncture in the upper right quadrant of the sac. The patient bore the operation well, his pulse ranging about 110 beats to the minute. At the close of the electrical séance there was no appreciable difference in the pulsation of the sac. This fact, together with the anatomical relations of the mass, made it seem very probable that the aneurism was one of the superior mesenteric artery, as in Case II. Except for middle-ear trouble, the patient's convalescence was uneventful. He was very happy over the marked improvement in his symptoms, insisting that he must be getting well because of the slight amount of pain compared with his former condition. But there was no appreciable improvement in the physical signs. On the day of his discharge, March 8, Dr. Osler made the following note: "Patient says he suffers less pain. He looks well. Pulsation chiefly seen in the epigastric region and appears a little more diffuse than formerly. On palpation the pulsation is most intense just below the ensiform. The tumor is still well felt on deep lateral pressure. No thrill felt. A soft systolic bruit is heard. No pulsation or murmur behind."

It might be argued that the current of 10 ma. was not sufficient in this case. But I am satisfied from the history at and since the operation that this was a case of fusiform aneurism, probably of the superior mesenteric artery, and its outcome is another argument in favor of the weaker current when we compare the results with Case II, which barely escaped an infarct of the whole small intestine from the sudden closure of the superior mesenteric artery.

*Dangers.*—Needless to say that sepsis is an omnipresent danger, especially in these cases characterized by large non-vascularized accumulations of blood and fibrin, and all details of surgical cleanliness should be strictly carried out.

One of the greatest dangers in this procedure, particularly in the large multilocular aneurisms, is the development and rupture of a secondary sac due to the rapid filling of the main sac by coagulum and the shunting of the blood stream against a portion not receiving a special strain before. Apparently this occurred in the cases of Domville, Cayley, Ransohoff, Hulke, Barwell, and in Stewart's first case. Loreta's unique case of rupture of the aorta at its juncture with the base of the former aneurism was probably caused, as he suggests, by lack of nutrition to the wall due to changes in the circulation brought about by contraction of the organizing sac. General arteriosclerosis would weigh against operation.

The chances of a loop of wire entering the aorta seem less than one would a priori suppose. Moore expresses surprise

that in his case, with large openings in the second and that interspaces connecting the extra- and intra-thoracic sacs, the wire entered the inner sac. The accident has occurred in three cases upon which autopsy has been held. In Ransohoff's case the aneurism of the ascending arch was very large, 4 x 7 inches, and its opening into the aorta was comparatively small, 1 inch in diameter; yet a loop of wire left the sac and descended low enough to interfere with one of the valves, causing syncope that for a few moments threatened death. In White and Gould's case the opening from the sacular aneurism into the large fusiform aneurism of the aorta easily admitted four fingers. A loop of wire entered the fusiform dilatation causing no symptoms. Reeves's case, which, from the report, seems to have been an ideal one for this method, possessed only a small opening from the perfect sac low down on the abdominal aorta. Through this opening the first end of the wire passed into the aorta and up to the aortic valves probably causing the syncope as in Ransohoff's case, and later a loop entered and passed up the aorta a distance of 10 inches. In none of these three cases was the character of the wire or its previous treatment such as to make probable its coiling after entering the sac.

One would suppose that a loop of wire in the aorta would whip out fibrin and present a menace in the form of emboli, but nothing is said of fibrin in any of these cases, while in the large fusiform aneurism of Kerr (his first case), where electricity was used, there was found a firm clot around the wire and on the walls. The wire had taken a position in the anterior portion of the sac and may have been out of the direct aortic current. In Stewart's third case there was no clot about the wire which had been in the fusiform aortic dilatation five days. While clinical experience shows that wire without galvanism will collect fibrin in the lessened current of a sac, it is probable that it will not do so in the active aortic current (see our last dog experiment). But our dog experiments demonstrate that wire with galvanism separates the fibrin even in an aortic current which is but little reduced, and in these cases in which the wire has entered the aorta and is found fibrin-free at autopsy we must believe that fibrin was formed during the electrical séance to be brushed off later and become a menace to life.

The size of the sac opening cannot be diagnosed from the character of the bruit although it is generally held that a double systolic and diastolic bruit is indicative of a small opening. Against this theory see Halsted's case.

Another danger is that of emboli breaking from the sac wall during or after the insertion of the wire. This may have been the cause of death in Roosevelt's case. No autopsy was held.

Halsted's case and Finney's first case bring up the danger of closing important vessels by the sudden filling with clot of an abdominal aneurism. Litten<sup>16</sup> by his clinical and experimental research demonstrates that sudden closure of the superior mesenteric artery can have but one result; namely, hemorrhagic infarct from the lower end of the duodenum to the middle of the transverse colon.

We have mentioned the possibility of puncture of the sac wall especially on passing steel wire. But this danger is more theoretical than real, for the wire begins to coil soon after leaving the needle and is almost sure to impinge on the sac wall with a segment of a coil rather than with its sharp end.

Loreta suggests the danger, in abdominal aneurism, of the sac giving way when the abdomen is opened, and the support of the abdominal walls thus removed.

Failure might result, particularly in aneurism of the thorax, because of the presence of a double sac, both intra-thoracic, as in the cases of Domville and of Corson, or one intra-thoracic and one outside the ribs as in the cases of Moore, and White and Gould; or one might successfully treat a sacular dilatation of the aorta, and still be confronted by a failure because of the presence of a fusiform aneurism. Such anatomical conditions were found in the cases of Domville, Cayley, and White and Gould. Failure in Hare's first case (Case XV), the fifth case of Stewart (Case XIX) and in Finney's second and third cases (Cases XXI and XXII) was possibly due to the insufficient filling of a large single sac; but it is more probable that each of these cases possessed a multilobular sac and the gradual extension was due to bulging of unfilled loculi.

Failure must be expected if an error in diagnosis be made and a fusiform sac be treated—as in Stevenson's case, Kerr's first case, Stewart's third case, Finney's first case, and Corson's case.

*Results.*—Do the results so far obtained justify a continuance of this method? With Moore's method of wire alone we see that 14 cases have been treated, 8 thoracic and 6 abdominal. Two of these, Morse's and Langton's cases of abdominal aneurism, resulted in cure. Loreta's case of abdominal aneurism resulted in cure of the aneurism but unfortunately the patient died three months later from rupture of the aorta. In all but four of these cases, those of Murray, Loreta, and Morse and Langton, it is definitely stated that the patient was in a desperate condition and it is a matter of speculation how much death, occurring in from one day to one month after operation, was hastened. Rubio's case was lost sight of after four days. Lange's case had already ruptured before treatment. Of the remaining nine, not counting Loreta's, Morse's and Langton's, we get the impression that death was hastened in four, those of Moore, Hulke, White and Gould, and Stevenson. Autopsy was held in nine cases and in all the effect of the wire in whipping out fibrin was marked.

With the combined method (Moore-Corradi) there have been 23 cases, 17 thoracic and 6 abdominal. Four of these, or 17 per cent, 3 thoracic and 1 abdominal, were cured. Here we must speak with reserve, for knowledge of the living patient or proof gained by autopsy are at our command for but two of these cases. Rosenstein's patient after 11 years is alive and well. Stewart's second case was one of definite cure as shown by autopsy more than 3 years after operation. It seems fair to consider Kerr's second case cured. He left the hospital two months after operation, with every indication of

having been cured, was watched at work as street paver for 10 months and then lost sight of, although he promised to return should he ever have more trouble. Noble's patient lived 8 months with no signs or symptoms of his abdominal aneurism and died from an entirely different cause.

Nine cases, or 39 per cent, attest the value of the operation by amelioration of symptoms and prolongation of life. Here again we must not be too sanguine, for in any given case we cannot prophesy as to his length of days or degree of suffering if there be no operative interference. Buresi's case was greatly relieved but soon died, 3½ months. Hershey's case, apparently cured, returned to his very active work as mining prospector, and had no trouble until 12 months after operation, when the symptoms of aneurism again developed and he died from rupture two months later. Stewart's fourth and fifth cases were decidedly improved, one living 8½ months and the other 9 months after the first operation. Hare's first patient enjoyed comparative comfort for 6 months after operation but died at the end of 7 months. His second case lived 7 months after the first operation and Dr. Hare says there can be no doubt that his life was prolonged. Finney's second case improved so far that he considered himself cured and resumed active life as a sea-captain. He died 6 months after operation. As nearly as one can judge, the life of Finney's third case was prolonged as a result of 3 operations, although he lived but 11 weeks after the first operation. His fourth case is still living with great improvement in his subjective symptoms.

Death was probably hastened in the remaining ten cases: Barwell, 7 days; Roosevelt, 23 days; Abbe, 2 days; Kerr, first case, 18 days; Stewart's first and third cases, 9 and 5 days respectively; Halsted, 2 days; Finney, first case, 20 days; Corson, 2 days; Reeves, 24 hours.

Clinical and post-mortem evidence points to the efficacy of this method. Its great drawback is the difficulty of accurate diagnosis. If we consider that none of these cases were picked as being favorable for operation; but, on the contrary, that they were almost without exception considered hopeless cases, I think we are forced to give the method careful consideration. The fact that the method is still in its infancy and in many instances most crudely applied makes the record still more impressive.

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13. Duncan and Fraser: Tract. Edinburgh, 1867. The Treatment of Aneurism by Electrolysis with an Account of an Investigation into the Action of Galvanism on Blood and on Albuminous Substances.

14. Stevenson: Lancet, London, June 11, 1887.

15. Litten: Virchow's Archiv, 1875, Vol. LXIII.

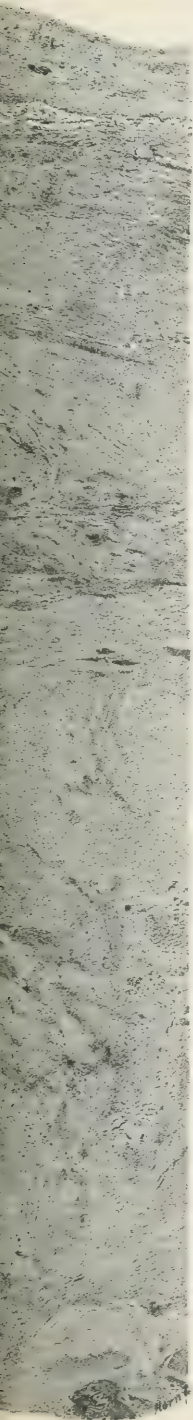
#### DISCUSSION.

DR. OSLER.—Demonstration of Dr. Finney's third case (Case XXII) after his first operation. On admission this man presented a very remarkable picture. He had a pulsating area in the inframammary region close to the sternum, and a right-sided effusion. We were in some doubt at first whether it was not a case of pulsating pleurisy, but the pulsation persisted after withdrawal of the liquid and it gradually became more localized, and began to project. There was a loud bruit over it, which was transmitted to the back. Dr. Finney wired it and since the operation the local condition has improved. The redness has disappeared, and the impression of both heart shocks, the systolic and diastolic, which could be felt upon the slightest touch of the finger, is no longer present. The tumor has become harder and altogether the signs indicate that there is coagulation going on in the sac.

DR. FINNEY.—The fifth case of Dr. Stewart's was a patient of Dr. John Neff, of Baltimore, whom I had seen in consultation. We had arranged to have him enter the hospital here for wiring, when some kind friend, very wisely no doubt, advised him to go to Philadelphia to Dr. Stewart. He has operated upon him three times with temporary benefit, after each operation. As Dr. Neff is present, perhaps he can tell us something about the case.

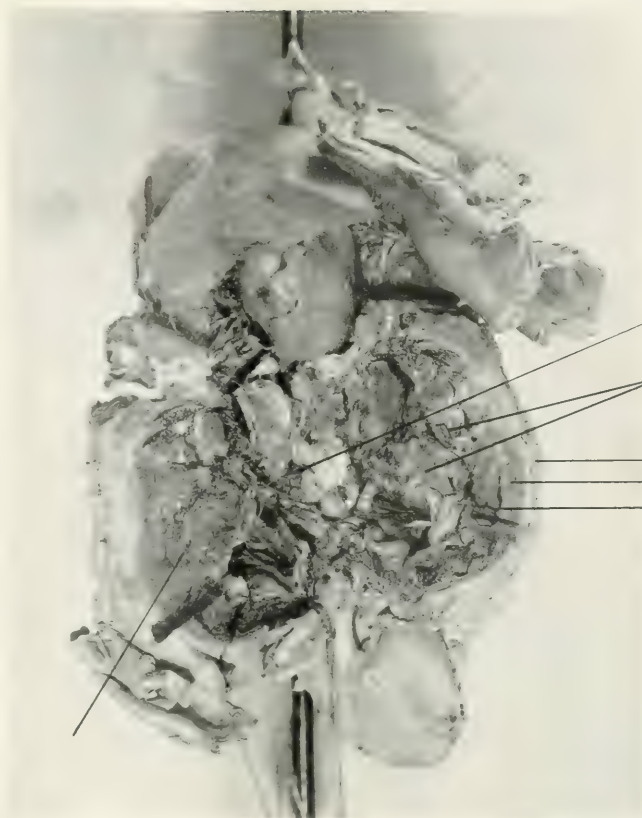
DR. NEFF.—I shall be very glad to furnish what information I have of the case. This gentleman's trouble was detected about three years ago and he was given a thorough iodid treatment with as much rest as we could enforce. There was some benefit resulting and he resumed his occupa-





a Extreme peripheral wall—compact fibrous portion—showing, in different regions, incorporation of nerve elements, blood vessels—thrombosed and patent, lymph glands and vessels, fat tissue.

b Looser red portion of wall, showing the same tissues as a) being separated by the blood elements.



Dilated mouth of sup. mes. artery.

c Newly formed clot with wire zone in center.

d Whitish fib. } Enscrous portion, }  
e } artery wall,  
f } Red portion, }

Wire ends

Aneurysm—Fusiform—Superior Mesenteric Artery—Path. No. 1144.

c Newly formed clot with wire zone in center, opposite the letter c.



1

2

3

1. 20 ft. (100 cm.) Drawn from No. 8 to No. 25.  
2. 54 ft. (16.5 m.) Wire. Drawn from No. 8 to No. 25.  
3. 11 ft. (3.3 m.) 0.5 minutes and then passed through a piece of No. 10 wire (No. 10 of 7).



tion, that of traveling salesman, again, but after a while came back worse, and I advised an operation, as I had read the report of Dr. Stewart's cases. He had some relatives in Philadelphia who advised him to consult Dr. Stewart, because he had done so many of these operations. I was present at the operation and Dr. Stewart introduced 12 feet of wire. The evidences of clot were very manifest, and you could not hear the bruit so directly in front as before the operation. He was subjected to a very rigid diet and absolute rest, remaining on his back for four weeks, not even elevating his head, and ice was applied over the region of the aneurism. At the end of that time he was allowed to walk around carefully but was kept in the hospital 8 weeks longer.

He seemed considerably benefited when he came home, but after awhile there appeared another point of protrusion and he went back for another operation. He remained under observation for one month, and then, another protrusion pre-

sented itself, he was again operated on. I saw him only last week, just before starting for Philadelphia, expecting to have to be operated upon again, as there are two protrusions now. He is suffering from pressure on the trachea, also, and cannot take anything but liquid food. I do not believe he can live very long in the condition in which I saw him last, and I do not see how anything can be done now that will prolong his life to any extent. He had suffered intense pain before the first operation, but while the suffering has been ameliorated there has been no permanent success attending the operations.

DR. OSLER.—Aneurism of the aorta is so hopeless that it is very encouraging to hear Dr. Hunner's paper, particularly on the question of increasing the perfection of the technique. In the natural method of cure in aneurism gradual depositions of fibrin take place at the surface of the sac, and with a perfect technique, entailing a minimum of risk, repeated operations could be performed.

## OBSTETRICAL PARALYSIS, INFANTILE AND MATERNAL.<sup>1</sup>

BY H. M. THOMAS, M.D.,

*Clinical Professor of Neurology, Johns Hopkins University; Neurologist, The Johns Hopkins Hospital and Dispensary.*

The force which is required to complete the act of parturition is, at times, a source of danger to the peripheral nerves of both the mother and child. It is to some of these traumatic cases of obstetrical paralysis that I wish to refer in this communication.

I have seen five such cases during the present year. Two occurred in mothers and three in babies; in one instance a mother and baby were paralyzed at the same labor.

This experience, which was unusual to me, interested me in these cases, and I trust that a short abstract of the histories may not be out of place at this meeting.

Duchenne's obstetrical paralysis of the arm in infants is not very uncommon and we are all familiar with its characteristics. Much has been written about it, and I should not presume to speak of it here were it not that some recent work has been done on the subject from the standpoint of the obstetrician that may be as new to some of you as it was to me.

Before referring more fully to this recent work, I shall give as a standard of contrast a free translation of Duchenne's conclusions.\*

"Certain violent obstetrical measures, which may be necessary during the difficult lowering of the arm after the body of the infant has been born, or the strong traction on the shoulder by a finger introduced in the shape of a hook into the axilla, after the head has been born, may at times produce a paralysis of the arm, localized in the deltoid, the infraspinatus and the flexors of the forearm and characterized by the falling of the arm close to the side of the body, the rotation of the arm inwards and the extension of the forearm on

the arm. The prognosis of this paralysis is, in general, grave; it may be cured by local faradization, but if this is abandoned, it becomes incurable and produces atrophy of the member."

Erb<sup>2</sup> speaks of the similarity of the cases described by Duchenne to those in which the brachial plexus is injured in adults. He confirms Duchenne's clinical picture and points out that the injury is to the 5th and 6th cervical roots, probably at the point in the neck, the stimulation of which by the electrical current causes a contraction of the muscles involved in this form of paralysis. This, the often-called Erb's point, he describes more accurately in his *Handbuch der Elektrotherapie*, 2d edition, 1886, p. 305.

"A point can be discovered from 2 to 3 cm. above the clavicle and somewhat outwards from the posterior border of the sternocleidomastoid muscle, and just in front of the transverse process of the 6th cervical vertebra, the stimulation of which causes a simultaneous contraction of the deltoid, biceps, brachialis internus and supinator longus muscles (apparently usually also of the infraspinatus and subscapularis)."

Erb thought that the plexus might be injured by many forcible obstetrical procedures, but he blamed particularly the so-called "Prager Handgriff," in which the finger is placed above the clavicle and pressure made directly over the point that he described.

After this it was generally believed and taught that this form of paralysis was due to pressure on the brachial plexus at Erb's point. Why such varying conditions as are known to produce the paralysis should always make pressure at just this point, was not explained.

<sup>1</sup> Written for the American Neurological Association, 1900.

<sup>2</sup> *De L'électrisation localisée*. 3d edition. 1892, p. 361.

<sup>3</sup> *Ziemssen's Handbuch*. Ed. XII. 1ste Hälfte, 2te Auflage, 1876, p. 529.



C. F. Carter<sup>4</sup> advanced, for the first time, the theory that the stretching of the upper roots of the plexus and not pressure on the plexus, in the great majority of cases, was the cause of these obstetrical paralyses. He arrived at this conclusion from his inability to explain the cases by any of the accepted hypotheses, and not from any dissections or experiments.

G. L. Walton<sup>5</sup> in his interesting paper on the Etiology of Obstetrical Paralysis, speaks of the unsatisfactory character of the explanations of the causes of this paralysis. Carter's theory he considers the best, although he would expect paralysis of the pectoralis major, if the plexus were injured where Carter supposed; but, on the other hand, if the plexus were injured by pressure against the clavicle, as Oppenheim supposed, the scapular muscles ought not to be affected.

Walton dissected the brachial plexus and found that the suprascapular nerve is given off high up and runs independently; so he thinks it must be injured separately, probably by pressure either against the suprascapular notch, or against the outer edge of the scapular spine.

Walton lays stress on rotation of the child's head combined with traction, as an important factor in the production of these paralyses. He, in association with Dr. J. J. Thomas, made some experiments, which for some reason were not conclusive, except in one regard, which I quote from the original:

"One point of interest we have established, however; namely, that when the body is placed in the position suggested, with the face rotated and the head forcibly drawn away from the shoulder, the clavicle is brought up sharply against the dorsal curve of the first rib. This point of contact is, therefore, the probable seat of injury of the brachial plexus, excepting the suprascapular branch."

If I have understood Dr. Walton rightly, his belief is that the nerves are stretched against some resisting point, the edge of the clavicle, and the suprascapular notch for instance, and so injured.

Fieux,<sup>6</sup> in 1897, apparently without knowledge of the work that had been done in Boston, laid great stress on the stretching of the brachial plexus as the cause of this paralysis. He made dissections and experiments to show that it was the upper roots of the plexus that were most stretched, and particularly so when the head was bent laterally. Indeed, he was able by this maneuver to actually rupture the 5th and 6th cervical roots.

Fieux thought that the experiments that he did, showed that it was impossible to constrict the plexus between the clavicle and the spinal column, or to injure the nerves by the application of forceps.

He will not admit that any other factor takes part in the causation of obstetrical paralyses, and explains them all by an undue traction on the neck with lateral flexion.

Cibert,<sup>7</sup> in an excellent thesis, written in the same year,

but after the publication of Fieux's article, reviews the whole subject and gives many references to literature. He refers to Carter's, Walton's and Fieux's papers, and accepts the theory of stretching as explaining the great majority of cases. He is, however, not so positive as Fieux in his statement that traction on the upper roots of the brachial plexus is the only possible cause of such paralyses. Cibert concludes his article with an excellent table of seventy-six cases which he found in literature.

Schoemaker of Nymwegen,<sup>8</sup> after a short report of two cases of obstetrical paralysis, reviews the subject, especially in relation to Fieux's article. He repeats the experiments made by this author, and, for the most part, confirms his results. Schoemaker found that if the neck be stretched in the direction of the axis of the body, the upper roots of the brachial plexus are put upon a certain amount of tension; that if during the traction the head be bent forward or backward or rotated, this tension is not materially increased; but if the head be bent laterally, the tension becomes very much greater, the fifth root being most stretched, the sixth next, the seventh and eighth much less. Schoemaker was not able to rupture the fifth and sixth roots in the alcoholic specimen.

He was able to constrict the 5th and 6th roots of the plexus by compressing the shoulders and pressing them upwards. This was more easily done if the arms were elevated above the head. The constriction occurred between the clavicle and the transverse process of the sixth cervical vertebra. It was so great as to make an indentation in the nerve roots. With forceps he found that it was not easy to compress Erb's point; indeed, he believes that it is not possible if the forceps are applied nearly in the direction of the axis of the body, but that it may be done if the forceps are applied at an angle of about 30 degrees. That the finger of the obstetrician may at times injure the brachial plexus at Erb's point he thinks is possible, although he believes it must occur very rarely.

Schoemaker shows how these various conditions may occur during labor, thus: In head presentations, the first danger is from pressure by the clavicles. This is slight, except in the few cases in which the shoulders are compressed and pressed towards the head. When the head is born then it is possible with the woman on her back, and the head hanging over the perineum, that the plexus may be so stretched as to be injured. If the head is grasped and traction is made with the head bent toward one shoulder, there is then great danger of overstretching the plexus. If the shoulders are still not born, and the finger is put in the axilla, and strong traction made, then it is possible that the clavicle may be raised and compress the plexus against the spinal column.

In cases in which it is necessary to use forceps, Schoemaker thinks that the danger here is also from stretching the plexus, although he admits that in certain cases the forceps themselves may injure the nerves. Very strong traction in the axis of the body may cause such a stretching as to injure the

<sup>4</sup> Boston Medical and Surgical Journal, May 4, 1893.

<sup>5</sup> Boston Medical and Surgical Journal, Dec. 24, 1896.

<sup>6</sup> Annales de Gynécologie, Tome XLVII, 1897, p. 52.

<sup>7</sup> Lyon Thesis, 1897.

<sup>8</sup> Zeitschrift f. Geburtshilfe u. Gynaekologie, Bd. XLI, Heft 1, 1899, p. 33.

nerves, although this is much more apt to occur when the head is bent laterally.

In breech presentations, the shoulders are often constricted and pressed towards the head, and it is in these cases that the plexus is most apt to be constricted between the clavicle and the spinal column. The danger is greatest when traction is made on the body and the arms are above the head. If the arms are born and traction is made by the fingers above the clavicles to deliver the head, it is possible to injure the plexus by direct pressure, but here again Schoemaker thinks that the chief danger is in stretching the nerve roots.

He finds in literature ninety-five cases of typical Duchenne paralysis in which the mechanism of labor is more or less accurately determined. Sixty-six of these cases he takes from Cibert's theses.

Of these ninety-five cases, fifty-five were head presentations. In ten of these labor was spontaneous; eight times the head was pulled upon with lateral flexion; ten times it was necessary to make traction with a finger in the axilla. In twenty-eight cases forceps were applied.

In forty cases the breech presented. In six of these the birth was spontaneous, but in thirty-four the child had to be extracted; of these last one or both arms were noted as being raised in thirteen cases.

Schoemaker thinks that if the dangers which occur at the various stages of labor are recognized, and the proper procedures are taken to meet them, very few cases of obstetrical palsy will occur.

From the neurological standpoint, the chief interest in these paralyzes is the grouping of the muscles which are affected. Why should an injury to the brachial plexus cause a paralysis which is limited to just these muscles, the infraspinatus, the deltoid, the supraspinatus, the biceps, the brachialis and the supinator longus? These muscles are supplied from various nerves which in their turn arise from different cords of the plexus. It is difficult to imagine any point in the plexus an injury to which would cause such a paralysis. Erb recognized this and supposed that the lesion was to the 5th and 6th cervical roots, and that it was the stimulation of these roots at the so-called Erb's point that caused the contraction of the muscles named.

The 5th and 6th cervical roots, however, send fibers to many other muscles than those paralyzed in these cases; and, on the other hand, these muscles receive fibers from other roots. A reference to Wichmann's<sup>2</sup> recent work will show how complicated the problem is and what very different views are held by the different investigators in this line.

It would seem to me that, although all muscles receive fibres from several spinal roots, that their movements are represented particularly in one or two roots, and that an injury of these special roots causes a paralysis of those muscles which are most represented in them. It seems fairly well determined that the muscles affected in obstetrical palsy have their chief representation in the 5th and 6th cervical

roots, and the experiments of Fieux and Schoemaker show that these roots are most apt to be injured during difficult labor, whether it is simply by the stretching of the plexus, or the squeezing of it between the clavicle and spinal column.

What are needed to clear up the question are careful post-mortem examinations, for we are almost completely without such data. Nonne<sup>3</sup> reports the examination of a case in which the roots of the plexus were pressed upon by a tuberculous growth and in which paralysis of characteristic distribution resulted. Oppenheim<sup>4</sup> refers to having examined a case of obstetrical paralysis in which there was degeneration of the 5th and 6th cervical roots. These two cases, as far as I know, are the only ones in which autopsies have been made, and they do not settle many of the points in dispute.

The cases which I wish to report are the following:

CASE I.—Johns Hopkins Hospital, Dis. Nerv. System, No. 10,465.

Bernard C. Six weeks old. Is brought on account of his not using right arm. Mother has had four other children and three miscarriages.

Birth was at term. The labor began at six p.m., the head presenting. Chloroform was administered at 11 p.m., and the forceps were applied. After the birth of the head, which offered considerable difficulty, quite a long time elapsed before the birth of the shoulder. The right arm was born first and traction was made on it. Labor was complete at 2 a.m. The paralysis of arm was noticed soon after birth. (History obtained from grandmother.)

P. C. The right arm is held at side, the elbow is extended and the arm is rotated inward. There is no evidence of a fracture or a dislocation.

The muscles paralyzed are the deltoid and supraspinatus, the flexors of elbow and the infraspinatus.

The electrical examination shows a slow lazy response of the paralyzed muscles to a weak galvanic current.

This patient was found dead in bed with his mother when about nine weeks old. No improvement had resulted from the use of the galvanic current. We were not notified of the child's death for several days and no autopsy was made.

The second case I saw in consultation, and it illustrates very well the danger of strong traction on the head with lateral flexion of the neck. The notes which the attending physician has kindly sent me are as follows:

CASE II. "The record I have in the case of Mrs. K. is as follows: 38 years old, 4 children, labors and puerperia always perfectly normal. Nothing of note as to present pregnancy. Labor occurred Nov. 21, 1899. Child in R. O. I. T. (i.e., head present, back to the mother's right). Labor was perfectly normal up to the delivery of the head. External rotation of the occiput took place to the mother's right, thus bringing the bisacromial diameter of the child into the anteroposterior diameter of the pelvis, with the left shoulder of the child under the symphysis and the right in the hollow of the sacrum. Labor was now arrested by the inability of the uterus to force the shoulders through the pelvis, and in order to save the child it was thought best to extract at once. This was done by grasping the head by the occiput and chin, and depressing it until the anterior shoulder slipped under the symphysis, when, by elevating the head, the other shoulder and body were delivered without much trouble.

<sup>2</sup> Die Rückenmarksnerven und ihre Segmentbezüge. Berlin, 1900.

<sup>3</sup> Deut. Arch. f. Klin. Med., 40, XL, 1896, p. 92.

<sup>4</sup> Lehrbuch der Nervenkrankheiten, 2d edition, 1898, p. 320.

"It was necessary to make strong traction on the neck of the child to free the anterior shoulder, and in this maneuver the brachial plexus on the left side was probably stretched.

"The cause of the dystocia lay in the size of the child, the mother's pelvis being perfectly normal, 22.5, 28, 34, and 20.5."

I saw the baby first on Nov. 29. It was a remarkably strong and active child. The left arm hung to the side with elbow extended and extreme inward rotation. Movements of fingers and of wrist were retained. Extension of elbow was strong, while there was no evidence of any action in the flexors. The shoulder could not be abducted nor the arm rotated outward. There was paralysis of the deltoid, the supraspinatus, the infraspinatus, the biceps, the brachialis and the supinator longus. The electrical examination was not conclusive, as I was unable to get any response either in the well or the paralyzed arm with any strength of current that I thought it advisable to use. A hopeful prognosis was given and the nurse was told to use gentle friction.

The child was seen again on Jan. 5, when a little more than 6 weeks old. The condition then was practically the same as before. Persistent passive motion combined with massage of the affected muscle was advised and the arm was galvanized about once a week upon the occasion of my visits. I was never able to determine the reaction of degeneration. The improvement began at once and was first noticed in the flexors of the elbow, then in the deltoid and finally in the outward rotation of the arm. The child was seen for the last time on Feb. 9, and was then practically well.

#### CASE III.—J. H. H., Dis. Nerv. Syst., No. 10,804.

Maggie C., 8 weeks old. Patient is brought by mother, who is under treatment for obstetrical paralysis of legs (Case V). The child's left arm has been paralyzed since birth.

The patient is the first child and is said to have weighed 12½ lbs. at birth. The mother has a contracted pelvis.

The labor was at term and was very difficult. The head presented. Forceps were used and had to be readjusted 6 or 7 times before the head was born; the shoulders then became fixed and traction was made on the head with the neck flexed towards the right shoulder. (The mother's sister, who gave the account of the labor, seems sure in regard to this.) The child did not breathe satisfactorily for some time after birth. There were bruises on the head and on the left side of the neck just below the ear.

P. C. There are no evident scars in neck. There is no fracture or dislocation about the shoulder joint. The left arm is held in the characteristic position, close to side, extended at elbow and rotated inwards. The wrist and fingers are moved voluntarily. The paralysis is of the deltoid, infraspinatus and flexors of the elbow. Electrical examination did not reveal the reaction of degeneration.

The child was ordered passive movements, massage and the galvanic current. The improvement was marked from the first, and the child, when seen last in June, 1900, was practically well.

In these three cases the head presented. Forceps were used twice. The cause of the injury to the brachial plexus can be determined definitely in only one case—the second. Here the only forcible procedure, in an otherwise easy labor, was traction on the head with strong lateral flexion of the neck, and the injury was surely due to stretching of the nerve roots. In the first case, where forceps were used to deliver the head, the right arm was next delivered and traction was made upon it, which may have elevated the clavicle so as to compress the roots between it and the vertebral column. It is also probable that traction was made on the

head, thus stretching the plexus. In the third case, where forceps and great force had to be used to deliver the head, it is conceivable that the blades of the forceps may have pressed upon the plexus. But here again strong traction with lateral flexion of the head was necessary to deliver the shoulders, and it is probable that it was this procedure that produced the paralysis.

The result in the two cases that lived was very satisfactory, but unfortunately such is not always the case, and I have seen a number of cases that have persisted until adult life.

The prognosis must, of course, depend upon the severity of the injury."

The nerves of the mother may also be injured by traumatism during labor. This has been recognized for a long time but the occurrence is not common and not much has been written about it. In books on obstetrics it is often not mentioned and in neurological books, traumatism during labor is usually simply included with the other causes of injury to the roots of the sacral plexus.

Lloyd,<sup>12</sup> however, has contributed an excellent chapter on the subject, and Mills<sup>13</sup> was one of the first to call attention to these cases. Hünemann,<sup>14</sup> from a review of the literature and a study of four cases in the obstetrical clinic at Berlin, determined that the paralysis resulting from trauma during labor nearly always had a definite distribution; *i. e.*, it affected exclusively or most intensely the muscles supplied by the external popliteal nerve. He explains this by the fact that this nerve receives its fibers mostly from the 4th and 5th lumbar roots and that these, after forming the lumbosacral cord, as they pass over the brim of the true pelvis to join the sacral plexus, lie next to the bone and are exposed to pressure whereas the lower roots of the plexus lie on the pyriform muscle, and are more protected. The injury, he thought, was due to pressure of the head and not to the blade of the forceps.

Hünemann's view has been generally accepted, and but little has been added to the subject since his paper.

The histories of the two cases which I have under treatment are, in brief, as follows:

#### CASE IV.—J. H. H.—Dis. Nerv., No. 10,159.

Mrs. G., æt. 26. Admitted July 29, 1899. Complains of weakness of right leg following labor.

Family and personal history unimportant. The first confinement was normal. The present trouble she dates from the birth of her second child. She had been well during pregnancy and up to the time of labor, which took place May 10, 1899. The membranes were ruptured at 7 a.m., but as there were no labor pains, she ironed all the morning. The pains began at 1 p.m., but were not very strong. Between 3 and 4 she began to have severe pain in the back of her right leg, between the knee and hip; there were no muscular spasms. The labor not progressing, she was given chloroform at 9 p.m. and the child

<sup>12</sup> See Sach's excellent article on Prognosis and Treatment (Nervous Diseases of Children, p. 223).

<sup>13</sup> Twentieth Century Practice of Med. Vol. XI, 1897, p. 307.

<sup>14</sup> University Med. Mag., Vol. V, 1893, p. 508.

<sup>15</sup> Arch. f. Gynækol. Vol. XLII, 1892, p. 489.



was delivered by the aid of forceps. The child died soon after birth.

The patient slept that night but in the morning complained of severe pain through the whole right leg. The leg was paralyzed and felt numb. The pain in the leg persisted, and only gradually improved after she got about. The puerperal period seems to have been perfectly normal except for the pain and weakness in the leg. The patient got up on the 10th day and was able to walk with the aid of a cane. The strength of the leg has improved to some extent, and the pain has slowly passed away. It was never aggravated by the passage of a constipated stool. The leg has always felt numb and cold below the knee.

The records of the patient during July and August, when she was coming every day to the dispensary for electrical treatment, show, in abstract, that there was complete paralysis of the muscles supplied by the right external popliteal nerve, with a certain amount of weakness in the muscles of the calf, and the flexors of the knee on that side. There was typical reaction of degeneration in the distribution of the external popliteal nerve.

The right leg below the knee looked somewhat bluish and felt cold to the observer's hand. The contrast in this respect between the right and left leg was marked. There was a distinct dulling of sensation to touch, temperature and pain over the outer half of the leg below the knee (the cutaneous distribution of the external popliteal nerve). There was no complete anæsthesia.

The knee-kicks were active on both sides, the reflex from the tendo Achillis was absent on the right side, but present on the left. Plantar irritation caused a flexor response on both sides.

The patient has come faithfully for treatment and has improved to some extent. The improvement, however, has been in the power of the flexors of the knee and the calf muscles, and now, nearly a year after the injury, these muscles are fairly strong, although they are still weaker than the corresponding muscles of the left leg. There has been no return of power in the external popliteal muscles. The muscles about the hip are all strong.

There is considerable atrophy of the right leg below the knee, the measurements showing that this leg is from 3.4 cm. smaller in circumference than the left. The leg is not so cold as it was, and the dulling of sensation, although still present, is not so marked.

Dr. J. Whitridge Williams was kind enough to make a pelvic examination and he found (April, 1900) that the measurements were practically normal and that there was no evidence of an inflammatory condition anywhere in the pelvis.

CASE V.—J. H. H. Disp. Nerv. No. 10,784. Admitted March 24, 1900. Mrs. C., æt. 25. Complains of weakness and pains in leg following the birth of her child.

Nothing bearing on the present trouble is found in the family or personal history. The child, which was born when the patient was injured, has Duchenne's obstetrical palsy (Case III).

During her pregnancy, which was the first, the patient was well up to the seventh month, at which time she began to have some discomfort, with pains referred to the lower part of the abdomen and the front part of thighs.

The labor began at 4 a. m. on Friday, Feb. 2, 1900. The pains were severe and the physician who examined her at 7 a. m. thought that everything was satisfactory and that the labor would be soon completed. The pains, however, became weaker, and at 6 p. m. it was decided to use instruments. The head was presenting.

Up to this time she had had no pain in her leg. Chloroform was given and she was unconscious for nearly two hours. She has been told that the physician had great difficulty in delivering the child and that the forceps had to be reapplied in or over ten times. Upon regaining consciousness she complained of great

pain in her legs below the knees. She was given morphia and slept during the night. The next morning it was noticed that both of her legs were paralyzed; the weakness was at first wide-spread, but affected the left more than the right. The pain was also severe and persistent and localized in the legs below the knees.

The confinement after the labor was perfectly normal. The patient at no time had any fever.

After three days she began to regain power in her right leg, and this improvement has continued steadily up to the present time, and she now thinks that it is nearly well. The pain which was referred to this leg has grown less and less severe and now she complains only of a numb sensation in the toes. The left leg has also improved to some extent, both in regard to power and the pain which is felt in it.

The pain has always been exaggerated by pressure on the legs and by a passage of a constipated stool. She is often kept awake at night by disagreeable subjective sensations, paresthesia, etc.

The patient got out of bed on the 10th day, but could not walk for three days.

P. C. The patient is a small, delicate-looking woman. Nothing abnormal is noticed about the functions of the cerebral nerves or of the arms and chest.

The patient walks in a remarkable manner. With each step she leans toward the side, so as to bring the center of gravity over the foot that is on the ground, in a manner very suggestive of a case of muscular dystrophy. Combined with this, there is the slapping gait of double foot-drop. The disability is more of the left side.

#### *Movements of hip-joint:*

Flexion, strong on both sides.

Extension, somewhat weak, more so on left than right side.

Adduction, fairly strong on both sides.

Abduction, weak, more so on left side.

Rotation out, fairly strong.

Rotation in, perhaps a little weaker.

#### *Movements of knee joint:*

Extension, strong on both sides.

Flexion, fairly strong on right side, weak on left.

#### *Movements of ankles:*

Extension (plantar flexion) strong on right side, somewhat weaker on left.

Flexion, possible on right side, but these muscles have very little power and are unable to resist any force applied by the examiner to overcome them. No power on left side.

#### *Movement of toes:*

Flexion, good on the right side, feeble on left.

Extension, weak on right side, impossible on left.

Electrical examination shows the partial reaction of degeneration in the muscles supplied by the right external popliteal nerve, and the complete reaction of degeneration in the corresponding muscles of the left side. The other muscles show no qualitative changes.

Pressure over the muscles, particularly those on the anterior part of the lower leg, causes pain.

No objective sensory disturbances can be determined, and there is no particular coldness of the leg. There is some swelling over the back of the left foot.

The kneejerks are active in both legs. The reflex from the tendo Achillis cannot be brought out. Stimulation of the plantar surfaces of the feet causes a flexor response of the toes.

Dr. Williams made a pelvic examination of the patient and sent me the following measurements:

"The patient has a moderately contracted pelvis, the measurements being as follows:

Distance between the anterior sup. spines of the ilium.....	24.5 cm.
Distance between the iliac crests.....	25
Distance between the trochanters.....	29
Diagonal conjugate.....	11
True conjugate.....	9+
Baudolouque's diameter.....	17.5

This is not a very marked degree of contraction, but with a large child may readily explain pressure upon certain nerves of the sacral plexus. The normal measurements are 26, 29, 32, 13 and 21 respectively, and you can readily see that there is a moderate degree of contraction in all diameters of the pelvis."

The patient has been treated with the galvanic current at the dispensary as often as she can come, and she has been directed to apply mild massage to the affected muscles when at home. She has improved considerably; the movements which were noted as weak have all improved in power to some extent. She is now (June, 1900), able to contract voluntarily certain of the muscles supplied by the left anterior popliteal nerve, although with not sufficient power to flex the ankle. Her walk has lost, to a great extent, its wabbling character. She no longer complains of pain.

These two cases are quite analogous and are, I think, good examples of injuries to the roots of the sacral plexus during labor (obstetrical paralysis of the mother).

In both cases the women had passed through a practically normal pregnancy. In both cases the labor was difficult and instruments had to be used. In the first case the pelvis was normal and the child was large; in the second, the pelvis was generally contracted and the child was very large (12½ lbs.).

In the first case there were symptoms that the nerve roots were being compressed (pain in the distribution of the sciatic) before there was any instrumental interference; in the other case there were no such symptoms.

In both cases some pain was complained of directly after the women came from under the influence of anesthetics and narcotics, and in both the paralysis was noticed at once.

The puerperium appears to have been normal in both cases, the women both getting up on the tenth day.

The paralysis reached its height at once in both women and improved to a certain degree in each case.

In the first case the right leg was alone affected, while in the second case both legs were paralyzed. The paralysis was most marked in the muscles supplied by the external popliteal nerve (the flexors of the ankle and the extensors of the toes); and, indeed, the only absolute paralysis was confined to this distribution. There was, however, a certain amount of weakness in the other muscles supplied by the sciatic nerve. In the second case there was weakness of certain of the movements of the hip joint, particularly abduction (gluteus medius), and to a less degree, extension (gluteus maximus) and inward rotation (gluteus medius), while in the first case no such weakness could be determined.

Electrical changes were demonstrated in the paralyzed muscles in both patients.

Pain was a prominent symptom in both of the cases; this was most intense at first and gradually subsided; it was localized on the outer side of the leg below the knee and on the back of the foot.

Paresthesia and other subjective sensory disturbances were

complained of. An objective dulling of the different sense qualities in the distribution of the cutaneous branch of the external popliteal was determined in the first case; no such disturbance could be found in the other. Vasomotor changes (coldness and blueness of the leg) were marked in the first case but were not noticeably present in the second.

Other than atrophy of the paralyzed muscles, no trophic changes were noticed in either case.

The knee-kicks were active in both cases, but the ankle-jerk could not be obtained on the right side in the first case nor on either side in the second, where both legs were affected. Plantar stimulation caused a flexor response in both women.

In the first case there is, after nearly a year's treatment, a complete paralysis of the flexors of the ankle, while in the second case, when the paralysis was much more wide-spread at first, there is some return of power in all the movements, after sixteen weeks.

These cases correspond closely to those which have been already recorded, but it may be well to refer particularly to one or two points which are somewhat unusual: Pain was a more pronounced symptom in our cases than would be expected from the description that is often given of this type of paralysis. A paralysis of both legs, as in the second case, is a very unusual occurrence, and I have not seen a description of a similar case; when it is remembered that, at the same labor, the baby's arm was also paralyzed, the occurrence seems still more remarkable.

In this case the weakness of the glutei, especially the gluteus medius should also be noticed. This gave to the walk its peculiar wabbling character. One would expect that these muscles would be more often paralyzed than the published records indicate, as they receive their nervous supply from the upper part of the sacral plexus.

That the cases which I have described were due to trauma of the roots of the sacral plexus, received during labor, seems to me to require no demonstration. I do not see what other hypothesis can explain the development, distribution and course of the paralysis.

We have not sufficient data to explain why there should have been undue pressure on the nerves in the case of the first woman except that the labor was difficult and protracted. Her pelvis is of normal size and shape. There was probably some abnormality in regard to the presentation, which if it had been recognized might have explained the injury.

In the second woman the conditions were just those that Hünemann believed to be most favorable for the production of these paralyses: i. e., a generally contracted pelvis and a large child. That the nerves were injured on both sides of the pelvis, may have been due to the fact that the forceps were reapplied several times and to the possibility that during these procedures the position of the head was altered and pressure was made first on one side and afterwards on the other.

In explaining the distribution of the paralysis, authors have generally accepted Hünemann's theory, that the injury is particularly to the lumbosacral cord on account of its ex-

posed position, and that from this cord the external popliteal nerve receives most of its nerve fibers.

But here again the conditions are not so simple as this would indicate. It is true that the lumbosacral cord does occupy an exposed position as it lies next the bone on the innominate line, and protected from pressure only by the blood-vessels which lie over it. This cord, however, sends fibers to the internal as well as to the external popliteal, and the latter nerve receives fibers from the first and second sacral roots, as well as from the lumbosacral cord. Dr. C. R. Bardeen, Associate in Anatomy Johns Hopkins University, has tabulated the actual condition found in about 200 dissections of the sacral plexus, made in the Anatomical Laboratory. Through the courtesy of Dr. Bardeen I am able to give some of his results in advance of their detailed publication. He finds it not unusual to have the external and internal popliteal nerves entirely separated up to their origin from the plexus (in about 10 per cent), and that in all cases it is easy to separate them with very little injury.

The common formation of the external popliteal nerve is from the fourth and fifth lumbar and the first and second sacral nerves (60.5 per cent). The common formation of the internal popliteal nerve is from the fourth and fifth lumbar and the first three sacral nerves (64.5 per cent). The following table illustrates in concise form the results found in 127 plexuses.

TABLE SHOWING THE GROUPS OF SPINAL NERVES WHICH CONTRIBUTED TO THE TIBIAL AND PERONEAL NERVES IN 127 INSTANCES.

Group of spinal nerves contributing.	Peroneal nerve.		Tibial nerve.	
	No. of inst.	Per cent.	No. of inst.	Per cent.
23d-26th (31-18) .....	1	.8		
23d-27th (31-28) .....	3	2.4		
24th-25th (41-51) .....	1	.8		
24th-26th (41-18) .....	30	23.6		
24th-27th (41-28) .....	77	60.5	18	14.2
24th-28th (41-38) .....	5	2.4	2	64.5
24th-29th (41-48) .....			10	7.9
25th-27th (51-28) .....	9	7.		
25th-28th (51-38) .....	3	2.4	1	7.9
25th-29th (51-48) .....			6	4.7
	127	99.9	127	100.0

In this table it will be noted that there is found at times a considerable variation from the normal origin of the peroneal and tibial nerves. In some instances a group of nerves more anteriorly situated, in some a group of nerves more posteriorly situated than normal, contributes to their formation. When a more anterior or a more posterior group of nerves than the normal contributes to the external and internal popliteal nerves, there is usually found at the same time an alteration in the relative position of the pelvis, so that the roots of the limb nerves have relations to the pelvis approximately similar to that which they have in normal conditions.

In most instances the peroneal nerve receives the bulk of its fibers from the fifth lumbar and first sacral nerves, and the tibial the bulk of its fibers from the first and second sacral nerves.

If one consults Wichmann's<sup>10</sup> monograph, it will be seen what a great number of muscles he finds represented in each of the roots that form the sacral plexus: 32 in the 1th lumbar, 33 in the 5th, 12 in the 1st sacral, etc., etc., each muscle being represented in from two to four roots.

All that can be said is that, on the whole, the muscles supplied by the external popliteal nerve are represented higher in the plexus than those supplied by the internal popliteal (lumbar IV-V, sacral I for the first and lumbar V to sacral I and II for the second).

It is not easy to understand how an injury to the lumbosacral cord (*i. e.* the fourth and fifth lumbar roots), could cause a motor and sensory paralysis so sharply limited to the distribution of the external popliteal nerve, as often occurs in obstetrical paralyses (our first case).

Dr. Bardeen has suggested as a possible explanation the fact that the branches of the roots that go to form the external popliteal nerve are given off from the dorsal aspect of the plexus<sup>11</sup> and lie next to the bone, while those forming the internal popliteal lie on them, and that, therefore, these dorsal offshoots would be apt to be injured.

With this addition to Hünemann's theory we might state the explanation as follows: *The upper roots of the sacral plexus do not lie upon the pyriform muscle, but against the bony wall of the pelvis, and are thus exposed to injury from pressure during certain difficult labors. It is the dorsal offshoots of these roots which lie against the bone and which receive the chief injury. The external popliteal nerve is made up from these dorsal offshoots, and therefore the paralysis is chiefly localized in the distribution of this nerve.*

The superior gluteal nerve supplying the gluteus medius and minimus muscles and the inferior gluteal nerve supplying the gluteus maximus also receive their nerve fibers from the dorsal division of the roots of the plexus, and it is interesting to note that these muscles are not infrequently paralyzed in obstetrical paralysis. Our second case is an example of this.

Although it seems clear to me that these cases are due to trauma of the nerve-roots during labor, the view has not been universally accepted. Lloyd<sup>12</sup> considers the question fully and concludes as follows:

"From the facts and authorities already cited, it is evident that there is some latitude for differences of opinion as to the exact causation of lesions of the sacral plexus and its chief trunks during labor. The older writers were evidently disposed to regard pressure by the head and injuries by the forceps in prolonged and difficult labor as important factors in causing these paralyses. The tendency of more modern writers is to dissent from this view, and to ascribe lesions of the sacral plexus and its branches to a septic inflammation, propagated directly to the nerve trunks from a metritis or a perimetritic cellulitis. I do not see that it is necessary to ignore either one or other of these important factors, although I believe that the theory of septic infection is one that more satisfactorily explains the

<sup>10</sup> Die Rückenmarksnerven und ihre Segmentbezüge, Berlin, 1900.

<sup>11</sup> See the excellent figure in Quain's Anatomy, Vol. III, pt. II, 1895, p. 324.

<sup>12</sup> Op. cit., p. 313.



majority of these cases. There can be little doubt, however, that in case of a large head or a contracted pelvis, the instruments, especially if applied in a faulty manner, might make pressure upon the sacral plexus where it lies upon the body of the pyriform muscle, or especially upon the trunk of the sciatic nerve where it emerges below the lower margin of that muscle, and where, by reason of its great size and its exposed position, it is liable to injury."

That the nerves may be involved in inflammatory conditions of the pelvis to such an extent as to cause paralysis is very generally stated upon good authority, but personally I have had no experience with such cases. They must be unusual for I have been unable to find the record of such a case in Dr. Howard A. Kelly's very active gynecological service. No such case has been referred to the neurological department for examination, and neither Dr. Kelly nor any of his associates can remember such a case. It may also be added that we have not seen a paralysis due to the involvement of the nerves during the growth of a pelvic tumor, which seems remarkable when one reads the statements in textbooks.

A good deal of the confusion is due to the habit of classing together all cases of paralysis which develop during the puerperal state under such general names as "puerperal paralysis" or "puerperal neuritis." This is manifestly a mistake as there are several conditions occurring during labor and confinement which cause paralysis.

Windscheit,<sup>19</sup> under the title "Neuritis gravidarum und Neuritis puerperalis," gives a very interesting summary of the different conditions which may be classed under the term neuritis. He divides puerperal neuritis into four classes:

1. Certain cases which had developed during pregnancy (neuritis gravidarum) and have persisted after confinement. The etiology of these rare cases is not known, but they are supposed to be due to the action of some poison circulating in the blood. The clinical picture is usually that of the pure motor form of neuritis. No especial nerves are liable to be affected. There is a gradual weakness of the different nerves of the extremities; the muscles atrophy and show the reaction of degeneration; trophic changes occur. The nerve trunks are sensitive to pressure. Slight sensory changes may be present. Pain is not frequently complained of.

2. Neuritis due to puerperal infection. Here the neuritis is purely local, due to the extension of the inflammatory exudates, so as to involve the pelvic nerve. Such cases have been recognized for a long time. He refers to von Leyden<sup>20</sup> but gives no other references. Under this head he also classes those cases following general pyemia, in which all the nerves of the body may be affected and not alone those of the lower extremities.

3. Puerperal neuritis due to traumatic injury during labor. To this group the cases which I have described belong. Windscheit has no doubt as to their cause, for he says "Es handelt sich hier um rein mechanische Momente."

4. Puerperal neuritis (Moebius). Under this head are grouped those peculiar cases first described by Moebius<sup>21</sup> and afterwards by other observers, especially Eulenberg.<sup>22</sup> These cases develop in women in whom pregnancy and confinement have been perfectly normal, and in whom there have been no other diseases from which the neuritis could have developed. Two forms are distinguished (Eulenberg):

- (a) The localized form. In this form only one or two nerves are affected. In the arm the median and the ulnar—the arm type. In the leg the crural—the leg type. Other nerves have also been found diseased, even the optic nerve. In these nerves there develops very soon after an entirely normal confinement, a paralysis with atrophy of the muscles and the reaction of degeneration. There is seldom any pain or objective sensory disturbance. The prognosis is not entirely good. Recovery may take place, but there have been more cases described in which this did not occur.

- (b) The generalized form. In this the paralysis develops in many nerves at the same time, and often after the manner of Landry's paralysis; i. e., the ascending type. The cranial nerves have also been described as affected. In these cases the prognosis is still graver than in the localized form, and death has occurred from the involvement of the respiratory nerves.

The cause of these cases is not known. Here again, as in the neuritis of pregnancy, some unknown toxic agent has been blamed. It has also been thought that the anemia following hemorrhage may have been the cause. Strong antiseptic douches have also been blamed.

It would seem to me to add clearness if the name puerperal neuritis were used to designate those cases classed in the fourth group. These cases are peculiar to the puerperal state, and as yet we know of no cause for them other than certain indefinite abnormalities dependent upon this state. It is probable that in this group there are cases belonging to different categories and that future examination will distinguish them. At present this does not seem possible, and they may well be classed together under the term "puerperal neuritis."

In regard to the other three groups, we have only to consider the second and third, for there is no reason to distinguish the first group from cases occurring in pregnancy (neuritis of pregnancy).

In the second group are the septic cases which seem only peculiar to the puerperal state in the time of the infection. The name *septic neuritis* (puerperal), with the qualifying subtitles, (a) local; (b) general, would seem to distinguish these cases.

In the remaining group, the third, are those cases which are believed to be due simply to trauma of the pelvic nerves during labor. This group might be named *traumatic puerperal neuritis*, if one classed every paralysis due to traumatic injury of nerves as a neuritis. This is not usually done, and the distinction between traumatic paralysis and traumatic neuritis is largely a matter of individual choice. It would.

<sup>19</sup> Sammlung Zwanglosen Abhandlungen aus dem Gebiete der Frauenheilkunde u. Geburtshilfe, v. Max Graefe, Bd. II, 1899.

<sup>20</sup> Charité Annalen, 1892.

<sup>21</sup> Münchener med. Wochenschrift, 1887, No. 9.

<sup>22</sup> Deutsch. med. Wochenschrift, 1895, Nr. 8 u. 9.

however, seem wise to distinguish these cases by a name that calls particular attention to the manner of their production. Duchenne called the paralysis of the baby's arm due to injuries of the nerve received during birth, *infantile obstetrical palsy*, or birth palsy. I would suggest that cases of paralysis occurring in women due to injury during labor be also called *obstetrical paralysis*, and that the adjectives *infantile* and *maternal* be used to distinguish the two conditions: Thus *infantile obstetrical paralysis* (Duchenne), or obstetrical paralysis of the infant; and *maternal obstetrical paralysis*, or obstetrical paralysis of the mother.

In this way emphasis is laid on the causes of these conditions, which being borne in mind, measures are more apt to be taken to prevent trauma during labor.

Schoemaker<sup>22</sup> tried to show how obstetricians should guard against injury of the brachial plexus of the child, and Huber<sup>23</sup> explains how he believes the nerves of the mother can best be protected.

This is an obstetrical question the full discussion of which would be out of place at the present time by the speaker. I shall endeavor, however, to summarize in a few sentences Huber's chief conclusions.

He believes that the birth itself is responsible for most cases of puerperal neuritis (a name which he uses in a very general sense), and that the physician should be on his guard against dangers occurring at this time. The chief danger is the undue pressure of the child's head on the nerves of the pelvis, which is more apt to occur the greater the disproportion between the size of the head and that of the mother's pelvis, and the longer the pressure is continued. He therefore says that the labor should not be allowed to continue longer than is absolutely necessary; that, if it halts, instruments should be used if the soft parts are sufficiently dilated. He is careful to state that this interference should be undertaken only under the strictest obstetrical rules; for, if these be disregarded, more harm may be done than if no interference were made. Badly applied forceps may themselves injure the nerves. He advises the early administration of chloroform to relax the muscles of the pelvis and to increase the available space. He has never seen any harm come from its administration but only good. He cautions against the too zealous employment of hydrotherapeutic measures directly after labor, and he thinks, for instance, that a cold sitz-bath at this time may cause an inflammatory condition of the nerves.

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## OXYGEN AND STEAM WITH THE VAPORS OF A SPECIAL INHALATION MIXTURE IN PULMONARY DISEASES.<sup>1</sup>

BY CLEMENT A. PENROSE, M. D.

At a former meeting of this Society I read a paper entitled "Infusion of Salt Solution combined with a special method of administering oxygen in pneumonia." This method consisted in passing the oxygen through a wash bottle containing one pint of boiling water in which had been placed one dram of a mixture of creosote, oil of turpentine and compound tincture of benzoinum. In place of the old delivery nozzle, a special funnel was used. The cases reported in that article, with others more recent, proved quite definitely the following: First, oxygen being heated and mixed with steam was more readily absorbed, less drying to throat and tongue, and more agreeable to the patient. Second, passed through a heated inhalation mixture like the above, it certainly had a marked antiseptic effect on the mouth and tongue, evidenced by sweetness of the breath and improved appearance of these parts, no matter how foul at the start. Might it not also have an antiseptic action on the lungs? Third, the pleasant odor of the inhalation mixture gave something tangible for the patients to breathe, who therefore made greater efforts to inhale the oxygen and keep the face under the funnel. This was especially true in children or semi-conscious patients.

Being much impressed by the benefits derived from inhalations of this character in pneumonia, it was decided to give the method a thorough trial in other pulmonary diseases, and this was done with remarkable success in a number of cases. In some of these oxygen being too expensive, compressed air was used, or simply steam alone, while in others I would give the oxygen at my office and have the patients use air or steam at home. The majority were treated in this manner. A few cases, and notably one case of tuberculosis, was treated with oxygen alone, the patient keeping cylinders of this gas at his home. The results in simple acute coryzas and various catarrhal affections of the pharynx and naso-pharynx, grip, acute and chronic bronchitis, etc., were really astonishing.

In a number of cases, purposely, no internal medication was employed, even in quite severe cases of grip, and yet results, when used early, were often about as good as when it was. Several inhalations, sometimes even one, occasionally being sufficient to bring the condition to a termination. I recommend for home use, where a cylinder of oxygen could not be afforded, the "Benzoinal Inhaler" or the "Hynson and Westcott Inhaler," a better modification. This is simply a tin can with an arm and mouthpiece into which one pint of boiling water can be poured. One teaspoonful of the inhalation mixture is then dropped in, the lid clapped on, and the patient breathes in the fumes as they arise from the hot water.

A number of families in this city are never without this little inhaler, which is utilized at the onset of the slightest

cold. From a number of cases, three have been selected, with the hope that they might be of interest to the Society, not only from the fact that they were hard cases to benefit, or represented pulmonary conditions of the worst type, but also because they were treated by the inhalation method in different ways, viz:

- 1st Case. Inhalation mixture and steam alone.
- 2nd Case. Inhalation mixture, steam and oxygen.
- 3rd Case. Combined method, inhalation mixture and steam at home; inhalation mixture, steam and oxygen at office.

**CASE 1.**—August 16, 1899. F. M., a barber, aged twenty-two, with chronic purulent bronchitis of several years' standing in spite of various treatments. On examination, this patient showed considerable emaciation, had a hacking cough, with much mucopurulent expectoration, containing numbers of pus and other organisms. The chest, which was long and narrow with limited expansion, contained numerous medium-sized moist râles and some piping and sibilant râles.

*Treatment.*—Simple iron tonic, inhalations three times a day of the inhalation mixture from a Benzoinal Inhaler, respiratory calisthenies and general gymnastic work. Result: rapid disappearance of sputum and organisms therein. In three months the patient was practically well. He has gone through a very changeable and trying winter without a cold, something which was never done before while suffering from his bronchial affection. At the time this was written, the patient has gained about ten pounds, and feels and looks like a different man.

**CASE 2.**—October 30, 1899. Mr. B. L., merchant, aged 59, with pulmonary tuberculosis. This patient gave a history of a chronic bronchitis of about twelve years' duration, with more acute symptoms the last year. On examination he was fairly well nourished, but pale and ill-looking. The chest was well shaped, but with limited expansion. There was decided flatness over the right infrascapular region, in which a number of gurgling, sibilant liquid râles were heard. These râles were also present at the apex and front. Down in the left subscapular region and around in the axilla a considerable number of dry crepitant râles were found. The patient had a hacking cough, especially in the morning, after which he raised a considerable amount of greenish-yellow purulent sputum. This contained numbers of pus organisms and a considerable number of tubercle bacilli. At time of first visit his temperature was only slightly febrile, but it had been much higher. The case was evidently one of tubercular consolidation in the upper right lobe just beginning to soften and break down.

*Treatment.*—Inhalations twice a day of oxygen passed

<sup>1</sup> Read before the Medical Society of The Johns Hopkins Hospital, Feb. 5, 1900.



through the steam inhalation, with regular breathing exercises and calisthenics. Creosote was given internally in two-minim doses and cod-liver oil. I will omit a detailed description of the improvement in this case, which was most striking from the very onset. The sputum rapidly grew less in amount, with disappearance of the pus organisms. The patient began to gain weight and noticed especially his increased energy. On February 5, after three months of treatment, the tubercle bacilli had entirely disappeared from the sputum, which was very scant. The gain in weight was over seven pounds, and the patient said he had not felt as well for years. An examination of the chest showed no râles, and but for slight evidences of consolidation was negative. The softening process had evidently ceased, and that of repair seemed to have succeeded. Since this time the patient has continued to improve, and now weighs 163 pounds, a gain of about 12 pounds since treatment was begun. He has had only one cold during the winter, which was readily thrown off, a most unusual event for him.

CASE 3.—The last case to be reported is one of great interest to me, representing, as it does, a rare pulmonary disorder, chronic infantile putrid bronchitis, and also because the little patient came all the way from Havana, Cuba, especially for this treatment. Her father, a man of considerable means, had spared nothing in his efforts to have his daughter cured, and had taken her on different occasions to the mountains of Cuba and Mexico, and also to this country (New York), for medical advice and treatment. The patient, Miss G. R., now aged thirteen, has kindly consented to be presented to the Society, and it can be seen at once she does not look much like an invalid. When one and a half years old an attack of severe bronchitis was followed by a gradual dilatation of the smaller bronchi of the lungs, a condition which was recognized by Dr. Pirez Miro, of Cuba. As the child grew up, this dilated condition of the bronchi became somewhat less marked, but was aggravated by an attack of pneumonia a few years later. She was never without a cough, suffered from severe asthma-like attacks at night, coughed up large amounts of very offensive sputum, with occasional yellow or blackish balls; *i. e.*, probably Dittrich's plugs. The child developed very slowly, had an almost continual fever, and for months at a time her life was despaired of. The mountain air in this case seemed to aggravate rather than relieve the conditions. In fact, while in the mountains of Mexico, she had the attack of pneumonia mentioned above, and could barely be moved home. When I first saw the case, June 3, 1899, examination showed a very small, thin girl, quiet and subdued in manner, weight only 54 pounds, with a cold, clammy skin, temperature 101° to 103°, tongue coated and breath very offensive. She had a continual hacking cough, with expectoration of much mucopurulent sputum of a greenish-yellow color, with considerable amount of frothy, lighter colored material. This sputum contained almost every kind of organism except the tubercle bacilli. There were chains of streptococci and bacilli, with abundant pus. The chest was narrow, ribs and clavicles very promi-

nent. Expansion limited throughout. The note on percussion rather hyperresonant over both lungs. On auscultation the chest was a virtual music-box. Sibilant, piping râles, harsh mucous râles, amphoric sounds, etc., were heard everywhere.

*Treatment.*—The treatment in this case consisted of inhalations of steam and inhalation mixture three times a day at home. Oxygen, steam and inhalation mixture two to three times a week at my office. Later, when the fever was less, breathing exercises and calisthenics were employed. Purposely no cod-liver oil or expectorants were used, as they had been tried so thoroughly in Cuba, and the only medicine taken was pepto-manganate of iron three times a day with alcohol sponges at night. The result, a rapid improvement, in a few weeks; cough and expectoration was much less, and almost free from bacteria; the breath was sweet and tongue clean; temperature slightly febrile; about three to four pounds gain in weight. In five months' time patient had *no expectoration*, and weighed 82 pounds, a gain of 28 pounds; she could run and play with other children and showed rapid development in every way. The fever had entirely disappeared. At the present time she weighs 87 pounds, and but for an occasional cough, more from habit and increased when excited, she is absolutely well. The chest, with the exception of a few dry, crepitant râles, due in great part to thickening of the pleura, is clear and shows an increase in girth of four inches, with a much greater degree of expansion. I have now begun to use cod-liver oil and creosote internally to see whether any additional benefit can be obtained. Since this was written the patient has had a severe attack of measles—which is generally so disastrous to those with any bronchial affection—without having in the least lost ground.

#### CONCLUSION.

The great quantity and variety of medicines taken internally for acute coryzas, bronchitis, grip, are appalling to the conscientious physician. In addition, numbers of compound remedies with very elaborate titles are daily prescribed for these conditions, some of the ingredients of which, or at least their dosage, too often escaping the memories of those using them. Inhalation methods are the rational means for combating pulmonary affections. Internal medication should be used as an accessory treatment, as for instance, a sedative mixture to relieve excessive coughing, etc. I do not consider diet in this category. Change of climate, mountain air, etc.—in reality inhalation treatments—are all very well for those who can afford them, but what can be done for the masses to whom this is an impossibility? Because many have found inhalations of various kinds of little value in tuberculosis, there is yet no reason to suppose the best treatment will not be found along these lines. I regret that only one case is at hand to demonstrate the utility of this method in that disease. The good effects of oxygen in pulmonary disorders are raised to a maximum when combined with the heated vapors of my inhalation mixture. This mixture has never yet proved irritating or dangerous to the healthy lungs, although possessing

such marked antiseptic properties. At the start a formula: Creosote (Beechwood), Olei Terebinthinæ ā ā drams IV, Tr. Benzoini Co., oz. III, is used (one dram of this mixture being placed in a pint of hot water). As the patient becomes more accustomed to the fumes, *i. e.* does not cough or choke during inhalation, gradually more of the creosote and oil of turpentine is added till a mixture of equal parts of each is obtained: Creosote (Beechwood), Olei Terebinthinæ, Tr. Benzoini Co., ā ā, oz. I.

Inhalations to be effective should be systematic and of sufficient duration, ten to fifteen minutes at least. An indispensable adjunct are breathing exercises and general gymnastic work. No physician can hope to have success in pulmonary diseases unless he makes a thorough study of chest development, calisthenics, and other forms of exercise. In fact, it is necessary that he have a love for this kind of work himself, and by personal example try to awaken in his patients—who, as a rule, are phlegmatic or indifferent—the enthusiasm so important in this kind of work. The excellent work by Dr. Dennison, of Denver, entitled "Exercise and Food in Pulmonary Disorders" has demonstrated the great advantages of such exercises.

The bacteriological examination made of the sputum in a number of my cases proves the marked antiseptic effect of the above inhalation mixtures, especially on the pus cocci. Now,

even if, as many authorities have shown, tubercle bacilli, being walled off, are protected from all inhalation vapors, when the severe symptoms so often due to secondary infection are eliminated and other portions of the lungs exercised and disinfected, beyond question a better chance is given to resist the spread of the morbid condition and to wall off completely the tuberculous area.

In addition, some persons will use an inhalation who could never be induced to take breathing exercises. The act of inhaling is, however, a very efficient exercise as any one can easily prove.

Inhalations rarely upset the stomach like cough syrups, etc., and eliminate much of the fatiguing routine of hourly medication. Children will inhale—smoke, as they often call it—willingly if a little diplomacy is used, where they often require force and much coaxing to take medicine.

The science of medicine has advanced beyond the point where we look to it merely for cures. The twentieth century brings with it more appeals than ever for instruction in the prevention of diseases, and especially of those of the respiratory apparatus. If we teach the tailor how to avoid a crooked back, the factory girl how to expand her lungs and utilize what fresh air she occasionally gets; if we place in the hand of the masses a simple method of avoiding colds, etc., we will find our clinics smaller, but our humanity larger.

## OBITUARY: JESSE WILLIAM LAZEAR.<sup>1</sup>

MR. PRESIDENT AND GENTLEMEN:

Before we proceed with the programme this evening, I should like to say a few words about our dear friend Lazear, whose sad death at Quemados, Cuba, on September 25, is so fresh in our minds. Lazear was born just outside of Baltimore thirty-four years ago. He graduated at the Academic Department of the Johns Hopkins University in 1889, and three years later obtained the degree of M. D. from Columbia University, New York. After this he was an interne in the Bellevue Hospital for two years. After spending the greater part of the year in studying abroad, particularly in Paris, he returned in 1895 and became one of the medical staff of the Johns Hopkins Hospital. In the summer of 1896, Dr. Lazear was married and began the practice of medicine in Baltimore. At the same time, however, he was an assistant in clinical microscopy in the University, and in the laryngological department in the Hospital dispensary. Last winter he obtained an appointment as assistant surgeon in the army with special laboratory duties, and was stationed in Havana. There he soon became interested in the study of yellow fever, and for several months he had been one of the commission appointed by the Surgeon-General, for the study of this dis-

ease. He had been constantly exposed to infection, and finally, in the course of his duty, contracted his fatal illness.

Dr. Lazear was a man of few words but keen perception. He was an extremely careful and thorough worker. He kept his own counsel, asked few questions and little help of his associates, but he was a man who, when he started an undertaking, had the ability and enthusiasm to keep quietly at work until he accomplished his end. It was through his excellent work that we were able several years ago to make our first positive *intra vitam* diagnosis of septicæmia due to the diplococcus of Neisser. His valuable studies upon the internal structure of the malarial parasite, which I had the pleasure of bringing before this society last winter, are remembered by all.

Personally, he was an exceptionally simple, high-minded and lovable man. He could not have failed to find in a short time a public position in which his unusual merits would have become more generally known.

I should like to suggest to the Society the adoption of the following resolutions:

"Whereas, On the 26th day of September, our beloved colleague and friend, Jesse William Lazear, lost his life in the discharge of his duty as a member of the United States Yellow Fever Commission;

"And whereas, His exceptional ability in his profession, his

<sup>1</sup> Remarks made by Dr. W. S. Thayer, at the meeting of The Johns Hopkins Hospital Medical Society, Oct. 16, 1900.

simplicity and modesty as a man, had greatly endeared him to all whose good fortune it was to know him;

"*Be it resolved*, That we, his former colleagues and associates, do hereby express our profound sorrow at the loss, to the community of one whose future was unusually rich in promise, to ourselves, of a dear friend and fellow student;

"*And be it further resolved*, That we express to his wife and family our warmest and most heartfelt sympathy."

The resolutions were unanimously adopted.

### NOTES ON NEW BOOKS.

**Diseases of the Nose and Throat.** By J. PRICE BROWN, M. B., L. R., C. P. E., Member of the College of Physicians, Ontario, etc. Illustrated with 159 engravings, including 6 full-page color plates and 9 color cuts in the text, many of them original. (Philadelphia, New York, Chicago: The F. A. Davis Company, Publishers, 1900.)

This volume, although rather too condensed for the specialist, can be heartily endorsed as a guide to the general practitioner in the diagnosis and treatment of such laryngological and rhinological cases as may come under his observation.

One is particularly impressed with its readability, the style being extremely fluent. The treatment, especially of the more prevalent conditions, is taken up in a simple and logical manner, which is easy to comprehend.

The chapter on examination is especially to be commended; and it is interesting to note that the author devotes considerable space (Chapter 63) to the description of Autoscopy, introduced by A. Kirstein, of Berlin, and brought forward in this country by Max Thorner, of Cincinnati, and discusses (Chapter 83) the uses of the Roentgen ray in laryngeal surgery.

General practitioners are in great need of books written especially for them by competent specialists. Doctor Price Brown's book will meet this demand in laryngology most satisfactorily.

C. A. PENROSE.

**A Text-Book of Diseases of the Nose and Throat.** By D. BRADEN KYLE, M. D., Clinical Professor of Laryngology and Rhinology, Jefferson Medical College, etc. With 175 illustrations, 23 of them in colors. (Philadelphia: W. B. Saunders, 925 Walnut Street, 1899.)

This book of 650 pages presents many points of interest. The classification of the various conditions from a pathological standpoint is very satisfactory, although there is much need of further work in the pathology of diseases of the nose and throat. The illustrations are, for the most part, original and appropriate. The details of treatment are fully entered into and are up to date.

In Chapter III, the use of the term catarrh is very properly deplored as indicating any definite disease. It is indeed better to use the adjective catarrhal in connection with special forms of inflammation.

In Chapter VIII, the nasal neuroses are thoroughly discussed with special reference to their etiology. Considerable weight is given to the effects of the pollen of plants as the exciting agent in many cases of hay fever. The author believes the term Hyperesthetic Rhinitis to be the most appropriate one for this condition.

The various neoplasms of the respiratory tract are taken up (Chapter XI) in great detail with especial reference to their

pathology and are carefully classified. In Chapter XXIII, the advantage of a preliminary tracheotomy in most operations on the larynx is denied, and a very suggestive method outlined for a complete laryngectomy with the patient in the "Trendelenburg" position, which is maintained for three days after the operation.

In order to attain completeness and to render reference less arduous, as stated in the preface, considerable repetition has been necessary, but this is by no means a fault, and adds much to the clearness of the book.

The author has unquestionably given to the medical profession a work of great merit—the result of much labor and careful thought, and one which will be of great service to every one desiring to be proficient in this specialty.

C. A. PENROSE.

**The Pathology and Surgical Treatment of Tumors.** By N. SENN, M. D., Ph. D., LL. D. Second Edition, revised. Illustrated by 478 engravings and 12 full-page plates in colors. (Philadelphia: W. B. Saunders, 1900.)

This new edition of a valuable work is welcomed by all who knew the worth of the former. The book is useful to both surgeon and pathologist, dealing thoroughly and conscientiously with all forms of tumors and presenting recent facts concerning them. The arrangement of material is practical, and insures an interesting recapitulation of the most important details of each subject considered.

The first twelve chapters, dealing with the origin, etiology, biology, pathology, clinical aspects, diagnosis, prognosis, treatment and classification of tumors, are the most interesting. They present a full scientific and practical review of much of the best and most interesting material which falls to the pathologist to study.

A short chapter on tumors in plants and animals, with references to the work on the parasitic origin of tumors, makes a very interesting *résumé* of our knowledge in this most actively worked field. Senn classifies tumors according to the embryonic tissue in which they develop, and adds a chapter on retention cysts, or swellings caused by the retention of physiological secretions. These cysts, he claims, cannot well be differentiated from tumors.

Senn properly states that we have not approached any nearer the solution of the question of the causation of tumors than the older masters. One expression repeated often in his book cannot be too deeply impressed on a student's mind, namely, that the tumor arises from a matrix of embryonic cells misplaced either in embryonic or in the post-natal life. In discussing the influence of the surrounding tissues on tumor growth, he ascribes to them a negative influence. There is, however, a growing tendency to assign a more active part to the tissues in which the tumor grows. Senn rejects the theory of the microbic origin of tumors. He would place them among the granulomata, if an infective cause were proven.

In describing special tumors, he gives their counterparts in the normal tissues of the body, and treats of them systematically under the following headings: Description, Histology and Pathology, Etiology, Transformations, Topography, Diagnosis, Prognosis, and Treatment. His chapter on Diagnosis is clearly and thoroughly written from the pathological and clinical standpoint, and most systematically arranged. It is of interest to note that he considers the microscope overrated as an aid to diagnosis.

Conservative and radical measures for the treatment of tumors are equally described; and where a radical operation is advised, it is described in detail.

The volume is well illustrated and printed, and is an authority in the medical world.



*Essentials of Diagnosis; arranged in the form of Questions and Answers. Prepared especially for Students of Medicine. By SOLOMON SOLIS-COHEN, M. D., and AUGUSTUS A. ESNER, M. D. Illustrated. Second Edition, revised and enlarged. (Philadelphia: W. B. Saunders, 1900.)*

This second edition of a deservedly popular hand-book of medical diagnosis has been thoroughly revised and considerably enlarged. The definitions are sometimes too much compressed to be clear, and the book generally may be said to suffer from an attempt to compress it into a narrow space. It contains an occasional personal observation, but for the most part the book is a compilation from other text-books. The work is methodically and painstakingly done, and the authors deserve much praise for their labor. It can but assist those persons who wish to renew their acquaintance with the science of medicine.

University of Pennsylvania. Contributions from the William Pepper Laboratory of Clinical Medicine. (*Philadelphia: Published on the Phoebe A. Hearst Foundation, 1900.*)

This volume of 479 pages contains thirteen original contributions to medical literature, the result of recent investigations conducted in the William Pepper Laboratory of Clinical Medicine. It is published in memory of the late Dr. William Pepper, through whose generosity the laboratory was founded.

There is an excellent photogravure of Dr. William Pepper. The style of the volume is pleasing to the eye. The paper and printing are excellent. The colored plates and the cuts in the text are fairly good.

It is impossible to attempt a digest of the various articles in a review of this kind, and while it would be an injustice to particularize, we think that some of the contributions deserve special mention. Dr. William Spiller reports two cases of muscular dystrophy with the gross and microscopic findings at autopsy. In another contribution he reports a case of amyotrophic lateral sclerosis in which degeneration was traced from the cerebral cortex to the muscles. The most elaborate report is by Dr. Alonzo E. Taylor. It comprises 180 pages, and in it he gives the result of his "Studies in Leukæmia," which are based on the study of sixteen cases. We had hoped to find some mention of Löwits's parasitic theory of the causation of both lymphatic and myelogenous leukæmia. We regret that Dr. Taylor has not studied the blood from this standpoint, because Löwits's views have yet to be confirmed, and they have recently been severely attacked by Türk, of Vienna. Dr. Stengel has an interesting contribution on the pathology of the erythrocyte. The other papers, although shorter, are fully as deserving of mention. There is also a list of the previous contributions from the laboratory.

The volume does full justice to the object it was intended to serve, and we take great pleasure in congratulating Dr. Stengel, the director of the laboratory. If we were to offer any criticism, we would point to the rather large number of papers in this volume and in the list of previous contributions which deal with the pathological side of medicine and which would seem more in place in the reports from a pathological laboratory than from a laboratory of clinical medicine.

*Surgical Anæsthesia, Addresses and Other Papers. By HENRY JACOB BIGELOW, A. M., M. D., LL. D. (Boston: Little, Brown & Company.)*

The first part of this volume of 378 pages contains a series of papers, arranged in chronological order, dealing with the discovery of surgical anæsthesia. The majority of the papers have been published in various medical journals, particularly the Boston Medical and Surgical Journal, but a few appear here for the first time. Those interested in the question of the priority of

the discovery of anæsthesia will find these papers particularly instructive, and the medical profession generally will find them entertaining reading.

The papers were written between the years 1846 and 1876. Throughout, Dr. Bigelow is an ardent supporter of Dr. Morton, whom he considers the discoverer of ether anæsthesia. Dr. Bigelow was a contemporary of Dr. Morton and was perfectly familiar with the facts concerning the discovery from the first. It was Dr. Bigelow who first publicly announced Morton's great discovery. The first time ether was used to relieve sensibility to pain in a surgical operation was on October 16, 1846. The anæsthetic was given by Dr. Morton and the operation was performed by Dr. Warren. Morton had previously used the drug in his dental practice in the extraction of teeth.

Dr. Bigelow strongly defends Morton against all others who attempted to claim priority in the use of ether as an anæsthetic, as well as against those who at first endeavored to belittle the importance of the discovery. Apparently Dr. Bigelow was not familiar with the claims of Dr. Crawford W. Long, of Jefferson, Georgia, to priority in the discovery of the anæsthetic effects of ether, as his name does not appear anywhere in the controversy. Many claim that to Long belongs the credit of the discovery. Long operated on his first case under ether on March 30, 1842, practically four and a half years previous to Morton and Warren's first case, and there are records of his having operated on eight cases previous to the date of Warren's operation. Unfortunately for Long, he did not publish his cases until after 1846. Dr. Bigelow would probably have answered Long's contention as he did that of others as follows:

"Many may have been the real discoverers of ether insensibility to pain, and at a remote period. But if so, they have kept it to themselves; and they will be known as discoverers only to themselves. The world has always honored that individual among such discoverers who presented his discovery to them. Dr. Morton was, according to the evidence in print, both the prime mover and the immediate agent in the introduction of this discovery to the world."

There is considerable repetition in these articles on anæsthesia, but the fact that they were contributed at various intervals during three decades merely serves to impress us with Dr. Bigelow's great readiness, as occasion arose, to do honor to Morton and his great discovery.

The second part of the volume contains a number of interesting addresses on general medical subjects. The most important of these are: "Fragments of Medical Science and Art"; "Science and Success"; "Medical Education in America." These impress one with Dr. Bigelow's clear style of writing and with his wonderful fund of general information. In the latter address, written in 1871, he comes out rather strongly on the side of the antivivisectionists, particularly against vivisection which occasions any degree of pain to the animals experimented upon. His views are further given in two heretofore unpublished letters on the question of vivisection.

*Medical and Surgical Report of the Presbyterian Hospital in the City of New York. Vol. IV, January, 1900. Edited by Andrew J. McCosh, M. D., and W. Gilman Thompson, M. D. (New York: Trow Directory Printing and Publishing Company.)*

It is difficult to do justice to all contributors to a volume of this kind, comprising, as this one does, twenty-two separate papers. The volume contains 223 pages. The articles are contributed by various physicians, surgeons and pathologists connected with the Presbyterian Hospital in New York.

The volume opens with a paper by F. Tilden Brown on the Surgical Treatment of Ascites due to Cirrhosis of the Liver. The object of the operation is to favor the establishment of compensatory anastomoses between the portal and general

venous system. The following papers deserve mention as being of special interest: "Remarks on the Surgery of the Biliary Passages with a Report of Ten Cholelithotomies," by Andrew J. McCosh, M. D.; "Typhoid Fever in an Infant Nine Months Old—Recovery," by W. P. Northrop, M. D.; "Report of Ten Cases of Subphrenic Abscess," by Forbes Hawkes, M. D.; "A Report of Twenty-eight Cases of Suppurating Hepatitis," by Stuart Hart, M. D.; and "Statistics of One Hundred Cases of Cancer of the Breast and the results of Operation," by Clarence A. Williams, M. D.

Sajous's Annual and Analytical Cyclopædia of Practical Medicine. Volume V. (Philadelphia, New York, Chicago: The F. A. Davis Company, Publishers.)

The high standard of its predecessors is maintained in this volume. It covers the subjects from "Methyl-blue" to "Rabies" inclusive, and contains 662 pages. The editor refers, in the preface, to the loss which he and the profession generally have sustained in the death of two of the associate editors since the publication of the last volume, viz., Dr. Norman Kerr, of London, and Dr. J. E. Graham, of Toronto. This volume embraces nearly all of the specialties—otology, laryngology, ophthalmology, neurology, pediatrics, obstetrics and therapeutics.

The late Dr. Kerr has given us the advantage of his experience in elaborating the excellent article on Morphinomania contributed by the editor. Of special interest to those who have the care of infants in their charge is the article entitled "Nursing and Artificial Feeding," written by Dr. Holt and Dr. Fétter, of New York. Some of the most important diseases of the lungs are included in this volume. Pleurisy and various affections involving the pleural cavities are treated thoroughly and concisely by Dr. McPhedran, of Toronto. The instructive articles on "Catarrhal Pneumonia" and "Lobar Pneumonia" are respectively written by Dr. Solomon Solis-Cohen and Dr. Thomas G. Ashton, of Philadelphia. The specialties have had full justice done them by the various contributors, and the practicing physician will obtain useful aid in the treatment of affections of the eye, ear and throat.

Short Papers on Nursing Subjects. By L. L. Dock. (New York: M. Louise Longeway, Publisher, 1900.)

This modest little pamphlet of 57 pages contains four short sketches which are of peculiar interest to nurses. "A Pilgrimage to Kaiserswerth" gives an interesting account of a visit to the scene of the labors of Pastor Fliebler, with a description of the present condition of the old mother-house. The tale is attractively told and is interesting to all, whether nurses or otherwise.

"Nursing Organizations in Germany and England" presents very clearly the differences which exist between English and German methods of nursing. In Germany everything is arranged according to law, and little scope exists for individual or independent action. In England there is more freedom and greater flexibility in the organization of nursing. The writer's personality is displayed in her references to the English pension fund, which seems to her to be the sum of all abominations instead of a benevolent scheme to help improvident nurses to put by something for old age.

"The Nurses' Settlement in New York" is an extremely interesting and readable account of philanthropic effort. It fails to give a very definite notion of what is actually accomplished by this and similar settlements. It is hardly worth while for nurses to live among the poor just for the sake of living among them or in order to show that they can so live surrounded by similar discomforts. If the life of a nurse in the slums tends to relieve the condition of the poor or to make their lot one whit less hard, there would seem to be some good grounds for such acts of self-renunciation on the part of nurses. If, how-

ever, life in the slums is merely to demonstrate that nurses can live among the poor, the outcome would seem to be wholly incommensurate with the output of effort and self-sacrifice.

The booklet represents the views of a very earnest and faithful worker in training-schools, among nurses and among the poor, and deserves to be read by all who are interested in the work of nurses.

Embryochemical Studies. By P. A. LEVENE. (*Archives of Neurology and Psychopathology*, II (1899), p. 557.)

The article gives an account of the first of a series of researches which will have for their object the study of the changes in the chemical distribution of nitrogen and phosphorus in the fertilized egg as development proceeds. The material used was the egg of the codfish, and this was examined in four stages: unfertilized, 24 hours after fertilization, 11 days after fertilization, and 20 days after fertilization. In each case the material was analyzed as follows:

The material was dried at 105°, extracted with very dilute hydrochloric acid and phosphotungstic acid added in excess. The nitrogen of the precipitate and residue was then determined as nitrogen of proteids and bases.

A second portion of the dried material was extracted in turn with boiling alcohol, ether, alcohol, boiling water acidified with acetic acid and cold water, and the nitrogen determined in the residue as nitrogen of total proteids.

A portion of eggs was extracted with cold and hot alcohol, cold and hot ether, and dried at 105°. In a weighed portion of this material the nuclein bases were extracted with sulphuric acid and weighed as silver compounds, while a second portion of the same material was submitted to the prolonged action of pepsin-hydrochloric acid and the undissolved portion weighed as nuclein.

It will be seen that the analytical results thus obtained furnish the data for calculating any changes that occur in the quantities of amido acids, proteids, nuclein bases or nucleoproteids as the development of the egg proceeds. While the author feels that it would be premature to draw any broad conclusions from the data thus far obtained, the results point strongly to the conclusion that in the course of development the processes of synthesis are preceded by those of decomposition. In the first stage after fertilization the proteids diminish in quantity and basic nitrogenous substances are formed at their expense. Later the basic substances decrease in quantity and the proteids increase. The combined proteids (nucleoproteids) and mineral substances greatly increase in the course of growth.

A continuation of this work should bring to light matters that are of interest.

On the Absorption of Proteids. By P. A. LEVENE and I. LEVIN. (*Archives of Neurology and Psychopathology*, II (1899), p. 553.)

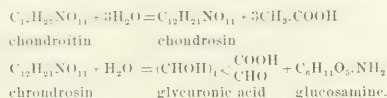
While it has been generally conceded that the products of proteid digestion are taken directly from the digestive tract into the blood and thus find their way to the other tissues, the recent work of Asher led him to believe that the prevailing view is based on inconclusive experimental evidence and that the principal path of absorption is the lymphatic system.

In order to test the correctness of Asher's statement, the authors performed a series of experiments upon dogs in which carefully prepared iodoproteid was ingested, thus adopting conditions which permit a clear differentiation of the proteid ingested from the tissue proteids. The ingestions were made variously in the large intestine and colon, in the small intestine and along the entire digestive tract, and the lymph was collected from the thoracic duct from one to seven hours after the ingestion; yet in no instance could iodoproteid be shown in the lymph. The experiments are very conclusive in showing that the lymph is not a path of absorption of the iodoproteids.



The Chemical Relationship of Colloid, Mucoid and Amyloid Substances. By P. A. LEVENE. (*Archives of Neurology and Psychopathology*, II (1899), p. 571.)

The very remarkable work of Schmiedeberg showed that the chondroitin-sulphuric acid of the cartilage is capable by hydrolysis of producing chondrosin, glycuronic acid and glucosamine; and it has since been found that chondroitin-sulphuric acid exists in some form of combination in the amyloid substance—



Levene now finds that tendomucin is a combination of a proteid with a nitrogenous ethereal sulphuric acid very similar to chondroitin-sulphuric acid since it yields chondrosin and that submaxillary mucin, as well as colloid of a colloidal carcinoma, contains very similar or identical ethereal sulphuric acids in combination. The work points very clearly to the conclusion that colloid, mucoid and amyloid substances are similarly constituted.

### BOOKS RECEIVED.

*Annual and Analytical Cyclopædia of Practical Medicine.* By Charles E. de M. Sajous, M.D., and one hundred associate editors, assisted by corresponding editors, collaborators and correspondents. Volume V. 1900. 4to. 662 pages. The F. A. Davis Company, Philadelphia, New York, Chicago.

*Clinical Examination of the Urine, and Urinary Diagnosis.* A Clinical Guide for the Use of Practitioners and Students of Medicine. By J. Bergen Ogden, M.D. Illustrated. 1900. 8vo. 416 pages. W. B. Saunders & Company, Philadelphia.

*A Manual of Personal Hygiene.* Edited by Walter L. Pyle, A.M., M.D. Illustrated. 1900. 12mo. 344 pages. W. B. Saunders & Company, Philadelphia.

*Atlas and Epitome of Diseases Caused by Accidents.* By Dr. Ed. Golebiewski, of Berlin. Authorized translation from the German, with editorial notes and additions by Pearce Bailey, M.D. 40 colored plates and 143 illustrations in black. 1900. 12 mo. 549 pages. (Saunders' Medical Hand-Atlas.) W. B. Saunders & Company, Philadelphia.

*Medical and Surgical Report of the Presbyterian Hospital in the City of New York.* Volume IV. January, 1900. Edited by Andrew J. McCosh, M.D., and W. Gilman Thompson, M.D. 8vo. xiv + 223 pages. Trow Directory Printing and Bookbinding Company, New York.

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In the methods of instruction especial emphasis is laid upon practical work in the Laboratories and in the Dispensary and Wards of the Hospital. While the aim of the School is primarily to train practitioners of medicine and surgery, it is recognized that the medical art should rest upon a suitable preliminary education and upon thorough training in the medical sciences. The first two years of the course are devoted mainly to practical work, combined with demonstrations, recitations and, when deemed necessary, lectures, in the Laboratories of Anatomy, Physiology, Physiological Chemistry, Pharmacology and Toxicology, Pathology and Bacteriology. During the last two years the student is given abundant opportunity for the personal study of cases of disease, his time being spent largely in the Hospital Wards and Dispensary and in the Clinical Laboratories. Especially advantageous for thorough clinical training are the arrangements by which the students, divided into groups, engage in practical work in the Dispensary, and throughout the fourth year serve as clinical clerks and surgical dressers in the wards of the Hospital.

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They are required to furnish certificates from officers of the college or scientific schools where they have studied, as to the courses pursued in physics, chemistry and biology. If such certificates are satisfactory, no examination in these subjects will be required from those who possess a degree in arts or science from an approved college or scientific school.

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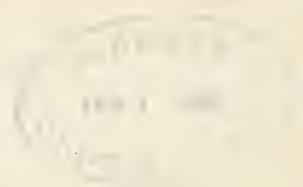
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# BULLETIN

OF

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## THEODOR BILLROTH, MUSICAL AND SURGICAL PHILOSOPHER. A BIOGRAPHY AND A REVIEW OF HIS WORK ON PSYCHO-PHYSIOLOGICAL APHORISMS ON MUSIC.<sup>1</sup>

BY JOHN C. HEMMETER, M. D., PH. D.,  
*Professor in the University of Maryland.*

In the following paper I have attempted a sketch of the life and work of a man who represents one of the most scholarly, versatile and inspiring characters in the history of German medicine; an investigator who accomplished and perfected achievements of enduring excellence in two arts, widely divergent—Music and Surgery; or, to state it in broader terms, in Biology and Medicine as well as in the Psychology of Music. For facts here narrated I have drawn largely from the various obituary notices and necrologies in German journals, and, for the second portion, from the introductory chapters to Billroth's book entitled "Wer ist musikalisch?" or "Psycho-Physiologische Aphorismen über die Musik."

#### BIOGRAPHY.

Christian Albert Theodor Billroth was born on the 26th day of April, 1829, in Bergen, on the beautiful island of

Rügen. Here, in the midst of a happy family, and subjected to various intellectual influences, he spent his youth. After leaving the gymnasium he studied at the universities of Greifswald, Göttingen and Berlin, and in 1852 received the degree of Doctor of Medicine at the last-named institution. His graduating thesis on this occasion was entitled "De natura et causa pulmonum affectionis, quæ nervo utroque vago dissecto exoritur," (Concerning the nature and cause of a pulmonary affection which arises from section of the vagus). It was thought to possess unusual merit at that time.

Billroth had become so conversant with all branches of medicine during his university studies under such men as Rudolf Wagner, Johannes Müller, Lotze, Schönheim and von Graefe, that even after he had been persuaded by von Baum and B. Langenbeck to devote himself to surgery, he did excellent work not only within the limits of his own specialty, but also in normal and pathological histology, physiology, and general pathology.

To broaden his views he journeyed to Vienna and Paris,

<sup>1</sup> Read before the Johns Hopkins Hospital Historical Club.



and spent some time at the universities of both places. In 1853 he received an appointment as assistant to B. Langenbeck at the Royal Clinic of the Berlin University.

Under this great master, he very soon acquired the art of operating. His extraordinary skill in this direction and ability to rapidly comprehend the surrounding conditions of a case, together with his decision and steadiness of character, proved to be of the greatest importance to him.

In 1856 he was already doing good work as Privat-Docent at the Berlin University, and a few years later he had come to be regarded as the most prominent of the younger surgeons of Germany, not only with respect to his operative activity, but also on account of his work as an investigator.

In 1860 he received a call as chief professor and director of the surgical clinic in the University of Zürich. This position at once afforded him that independence of action that was befitting him. Whereas in Berlin he had to attend to the diagnosis and treatment of disorders following surgical operations, and could only satisfy his innate yearning for original investigations by a historical and histological study of the rich material afforded by the clinic, he now, through a continuous study of the sick, could open up paths of his own. His most important investigations at that time dealt with septic fever and accidental wound infections. These studies which he afterwards continued in conjunction with his friend Weber and later on at Vienna, effected a complete revolution of thought with respect to the causes and nature of these conditions.

His "General Surgical Pathology and Therapeutics," the first edition of which appeared in 1863, showed him to be an accomplished teacher, who had illuminated with new ideas the entire field of surgical pathology and therapeutics. The work defined sharply the limits of knowledge on the subject and incited many others to independent critical study. Written in a most attractive and fluent style, it soon displaced all contemporaneous works and appeared, at short intervals, in many editions; even to the present day its attractiveness is undiminished. The publication of the ninth and succeeding editions was entrusted by Billroth to his pupil, A. von Winiwarter.

The best evidence of the great success of this work is the fact that it has been translated into the French, English, Italian, Spanish, Hungarian, Polish, Russian, Servian, Croatian, and Japanese languages.

Billroth contributed, moreover, a number of important articles relating to various branches of surgery, to the Archives of Clinical Surgery, the editorship of which he had shared with Gurlt ever since its foundation in 1860 by B. Langenbeck. He also stimulated his Zürich pupils to many investigations of importance.

When at the death of Schuh the second chair for surgery became vacant, Billroth received a call to Vienna from the Medical Faculty, upon the determining vote of Rokitsansky, Brücke, Skoda, Oppolzer and Hebra.

At the very height of his activity, handsome in appearance, and in the fullness of his vigor, he accepted the chair,

August 20, 1867. Nor was it without difficulty that he finally succeeded in organizing his clinic somewhat according to his own notions, and the most necessary buildings and hygienic arrangements, as well as other indispensable improvements, were accorded to him only step by step. So great indeed was the opposition, outspoken and covert, with which he had again and again to contend, that even to the last he did not succeed in obtaining, as he had long hoped he would, either an up-to-date clinic with modern equipments, or a remodeling of the entire hall, as planned by himself.

In one respect he could claim a quick and decisive victory. The enthusiasm and love of those who attended his lectures, and the reverence and admiration of his more intimate pupils were his from the beginning to the end.

A fascinating delivery, coupled with great fluency of speech, and freedom from all doctrinal tenets, attracted everyone about him. Ideas and views quite new to his pupils were developed, and pathological phenomena, as they appeared at the sick bed, were explained in the light of the latest physiological, pathological-anatomical, and experimental-pathological discoveries. The soul of science breathed life into his teachings; the love of truth, with which Billroth was completely saturated, made them real. Here in his new sphere of duty, he inaugurated that restless activity which made him a captive for his last twenty-seven years at the Vienna institution.

"Per aspera ad astra," and "Durch Klarheit zur Wahrheit," these were the standards under which he unfalteringly moved on from victory to victory.

Perhaps his greatest contribution belongs to the domain of practical surgery. Hardly had he arrived in Vienna, when he began to compile his report on the Surgical Clinic in Zürich, from 1860-1867, which was followed by one on the Vienna Surgical Clinic from 1869-1870, and finally a report on the latter clinic from 1871-1876, together with another on both conjointly. The value of these volumes, which could only have been collated at the expenditure of the greatest of industry and through an almost infinite capacity for work, is due not merely to the important contributions to practical surgery contained in them, but much more to the fact that Billroth for the first time presented to the world a complete account of his entire experience.

Collections of statistics on various subjects belonging to medicine and even surgery had existed ere this, but no one before Billroth had had the courage to appear before the tribunal of scientific criticism with his experience in its entirety, including, therefore, that of an unsuccessful, as well as that of a successful character. In this way he stimulated others, and caused them to do likewise. The generally accepted opinion of to-day is that this manner of utilizing the statistical method in surgery is the correct one.

The stirring events of the year 1870 carried Billroth along with them. He felt it his duty to proffer his assistance, and he did so generously, both at Weissenburg and Mannheim. His scientific contributions to the surgery of the Franco-Prussian War are to be found in the magnificent letters re-

ceived from him while at the hospitals for the wounded, which form the worthiest monument of Billroth's activity as a military surgeon.

No sooner had he returned from the field hospitals than he resumed his extended investigations concerning the vegetative forms of septic cocci.

At the close of the year 1874 he was in a position to present to the wonderment of the scientific profession the results of his experience in the form of a monograph.

The wealth of observational data stored up in it, and the manifold points of view from which he attempted to master numerous problems which had presented themselves during the course of his investigations, together with those magnificent ideas which acted as the precursors of demonstrable facts, bear witness to that stupendous and ingenious spirit of investigation which impelled Billroth onward with unmerciful force, and caused him to make good use of well-nigh the last minute of his rather scantily portioned existence. Many and many a night he would remain till late at the microscope and study his specimens. During this period of time, as we learn from Gussenbauer (Necrolog über Billroth), Billroth worked for months at a time from 16 to 18 hours a day.

Hardly had he finished this stupendous task, when he undertook an investigation in a direction apparently remote from his immediate profession. He gathered information concerning the arrangement and character of medical studies prevalent at the universities of all countries. He took an interest in this subject as no one had done before him. The outcome of his study was a book, "How to teach and study the medical sciences." It created a sensation at the time being, particularly in Austria. It aroused much opposition on account of the plain truths which Billroth unhesitatingly and without heed of possible consequences had expressed in it. Although many of his opinions may be now considered as rather too rigid, his book is still, and will remain for some time to come, a veritable treasure-house of the grandest ideas. His views have been accepted as the most practical dealing with the organization of medical instruction.

Over and above this activity—so extensive as to have alone furnished ample employment to even an exceptional mind during a lifetime—he wrote a long series of essays and papers in which he clearly defines his position with respect to everything of an important nature evolved within the department of surgery and pathology during the course of many years.

His monographs on wounds and their treatment, on scrofula and tuberculosis, and on diseases of the mammary gland, contained in the joint treatise on surgery by von Pitha and Billroth and in *Die Deutsche Chirurgie*, are graphic models of lasting value, and everywhere mark the expert clinician and physician.

His historical and critical studies on matters relating to the transportation of the sick and wounded, on nursing as practiced at home and in the hospital, show the lively interest he took in everything which was intimately connected with the cure of his patients.

Even during the last years of his life, when illness began

to annoy him, with constantly increasing intensity, he managed to keep himself thoroughly informed on all new discoveries in the spheres of surgery and pathology, and enlarged and supplemented them out of the rich fund of his own experience.

Many an idea which he has embodied in his treatise on the "Reciprocal Influence of Living Plant and Animal Cells," published in 1890, may be expected after thorough investigation to develop into facts of lasting utility.

At the inauguration of the Building of the Royal and Imperial Society of Physicians, Billroth made use of the occasion to summarize his entire experience on the treatment of aneurisms, and discuss the relative values of the various methods suggested.

Over and above all his very numerous publications, which show Billroth to have been one of the most productive and influential medical authors of the present century, he took upon himself an immense amount of the work involved in the editing of the *Treatise on Surgery* by Pitha-Billroth, of *Die Deutsche Chirurgie* by Billroth-Lücke, of the *Archives of Clinical Surgery* by von Langenbeck.

From Gussenbauer<sup>2</sup> we learn of still another treasure which Billroth has stored up in the course of decades. This work has not as yet been made public; only those who attended his lectures and his intimate pupils have had from time to time an opportunity to get a look at it, and appreciate what Billroth was doing in behalf of science at the cost of immense labor and a large expenditure of his own money.

I have reference to his collection of illustrations of diseases of rare occurrence, executed under his direction by celebrated artists. His long-conceived plan had been to incorporate this collection in a comprehensive work on special surgical pathology. It was not his good fortune to carry out this magnificent idea. His bodily powers did not suffice towards the end to keep pace with the onward movement of his indomitable intellect.

And what did not Billroth accomplish as an operator! Unequaled on the technical side of his art, and urged on by the noblest sympathy with the sick to help where others had failed to do so, he strove to extend the boundaries of practical surgery, and succeeded as no one before him had done.

Experimental studies on animals were first carried out, and not until the results of these, supported by all existing knowledge of the human body made the final outcome of the well-conceived operation promise more than a probability of success, did he proceed to the rescue of the otherwise doomed. His resection of the esophagus was followed by his extirpation of the larynx; these led to resections of the stomach and intestines and finally to extended innovations in the field of intestinal surgery, the limits of which have not yet been reached. To Billroth belongs the honor of having performed the first successful extirpation of the larynx, as well as the first successful resection of the stomach.

As a teacher Billroth stands preminent, for while train-

<sup>2</sup> Gussenbauer, loc. cit.

ing his numerous pupils in the ways of thinking, which his experience had taught him to be the best, he constantly incited them to undertakings of their own, and was ever ready to place at their disposal all the wealth of his own far-reaching knowledge. The force of his own brilliant example, and a certain subtle ability which he possessed of discerning the individual traits of each one, rendered his influence over his pupils all-powerful. Any one who had within him a genuine striving after progress was welcomed by Billroth.

In addition he seemed to have the rare power of forming a just estimate of differences of character. So unprejudiced and loving was his heart, so comprehensive his intellect, that he was capable of attracting to himself even those of unlike aims and wishes. Billroth's enthusiasm and energy of mind live again and flourish in his pupils.

And finally, what was he not as a man! Although coming from a family in which sickness had found an abode, nature nevertheless had amply endowed him with comeliness and strength of body and at the same time had equipped him so richly with sterling qualities of mind and heart, such as are not likely to be soon found united again in one individual. By means of strict, even unrelenting, education of self, he developed into that ideal model as he appeared to his pupils even to the end of his days.

He was a homogeneous whole, not one-sided, as is wont to be the case with so many professional men. His excellent musical capabilities were used to advantage and developed to such an extent that indeed, up to the very end, he obtained solace from this source whenever the grave and onerous duties of the surgeon threatened to oppress him. In comprehension and critical estimation of the masterpieces of the art, he could hold his own with the most famous artists and professional critics.

Wherever Billroth happened to be, he kept himself in close touch with men of prominence in their various callings; in this way he preserved himself from a narrow view of life and its phenomena, and ever maintained an active interest in everything that concerns the beautiful, true and good.

Nor was Billroth averse to the ordinary pleasures of life, considering them a necessary means of diversion for the mind. The decorations of his home, that magnificent Villa Billroth on one of the most beautiful spots on the Wolfgang Lake, were prompted by his own taste for the beautiful, and a desire to make his own, as well as the lives of those around him, as agreeable as possible.

Billroth may be certainly said to have been singularly rich in true happiness and honors of all kinds. Happily married in 1858 to Christel Michaelis, his domestic life was not without its trials and tribulations. His son died in Zürich, his daughter in Vienna. To his three remaining daughters he transferred all his fatherly love and care.

Among his personal friends and intimates were numbered members of many prominent families both in and outside of Vienna. To his numerous pupils whom he constantly assisted with his fatherly advice, and to whom, when in need, he oftentimes lent a helping hand, he proffered the hospitality

of his house. And here, within the circle of his family, Billroth disclosed the real man, possessed of all the truly magnificent qualities of mind and heart.

These very qualities, combined with a refined artistic instinct, chained him to Vienna, the city of the musical muse. Here he very soon felt at home; he became an Austrian and a warm patriot. His Austrian patriotism compelled him, a man from the North, twice to decline honorable calls to prominent universities of United Germany. In the year 1872 the University of Strassburg, which, during its reorganization, was richly endowed, offered him a professorship. After the departure of Jünkens from Berlin, he received a call to the Charité Hospital, but again declined. And even when Langenbeck himself, on his retirement from the most important surgical chair of the German Empire, declared Billroth to be his most worthy successor, the latter could not decide to return to his fatherland. He had found his home in Austria; he remained at the Vienna University. His only immediate reward was the grateful cheering of the Vienna students.

Proofs of his patriotism still remained in his creations of a benevolent character in Vienna. The Rudolfiner Association, with its grand hospital in Oberdöbling, and the building of the Royal and Imperial Society of Physicians in Vienna, are his works. Only a Billroth could have accomplished this work.

He was the recipient of a large number of decorations and distinctions from his own and foreign governments, as well as from many learned societies. Among the former he possessed the Russian Iron Cross—conferred for display of extraordinary bravery while in action with the enemy. As regards American Societies, he was a member of the Academia Chirurgia, of Philadelphia; the Pathological Society, of Saint Louis; and of the Societas Chirurgica Americana, of Washington.

Such was Billroth! This man won the hearts of all who knew him. He was honored and revered in numerous foreign countries, wherever the fame of his deeds had penetrated. Nor is he forgotten after death. The imperial capital assigned a grave of honor to him, and countless was the human throng which followed his hearse in deep sorrow for the man and for the scientist. His works and his fame among men still live and will live after him.

The circumstances under which Billroth's book "*Wer ist Musikalisch*" came to be written are stated in the following introduction written by his musical friend Ed. Hanslick:

Billroth at an early age gave evidence of love and talent for music, which, as he himself always insisted, was hereditary. His grandmother, Frau Wilkens, née Willich, filled an engagement at the Berlin Opera House as soprano, alongside of the then famous tenor Eunice—the first "*Florestan*" of Berlin—was also the grandfather of Billroth's wife. "In this way," so wrote Billroth to Hanslick, "I am truly a child of Music and the stage." When a boy he expressed the earnest wish to devote himself entirely to music, but his in-



tention was thwarted by the determined opposition of his mother, for which, however, later on he was deeply grateful. Not that this vigorously minded and cultured woman desired to suppress a love for music in her children; quite the contrary. There is still a letter written by her from Bergen, in which she reminds Theodor to give regular piano instruction to his younger brother punctually; both brothers were then studying in Berlin. Music remained Billroth's tried and beloved companion until the end of his days. During the years of his professorship in Zürich a string quartet met at regular intervals at his house, and on these occasions he himself played either the viola or second violin. He also wrote musical criticisms for the "Züricher Zeitung," and exerted an inspiring influence on the musical life, then at a somewhat low ebb, in that city. Being not only a good performer on the violin and piano, but also a refined connoisseur and earnest thinker in musical matters, he felt during the last years of his life an ardent desire to arrange, clearly outline, and write down his views concerning music. In this matter Hanslick gladly urged him on, inasmuch as he, through his two-fold position of expert musician and trained physiologist, appeared to be unequally fitted to throw light on that line of demarcation at which musical effects and the experience of our nervous system meet.

Billroth's work progressed bit by bit, and was often interrupted. He only succeeded in doing consecutive work on it, at long intervals, during his vacations in St. Gilgen or Abbazia. During the summer of 1888, he seems for the first time to have busied himself more constantly and coherently with his musical views. At that time he wrote from St. Gilgen:

Who is musical? This would be a heading for you for an essay. How complicated this idea is! One man is possessed of especial susceptibility for rhythm (the most elementary rhythmic principle of the human body is the heart-beat); another is endowed with a decided talent for melody (melody cannot be separated from rhythm; the articulation of the human body and its twofold arrangement, with respect to a horizontal and a vertical axis, are a part of its fundamental formation); a third man appears to be musical owing to an outspoken technical and mechanical ability (elementary principle; the pleasure experienced in overcoming difficulties as the chief result of an intensified feeling of self-consciousness); in a fourth, music seems to be the expression of an intense exhibition of emotion as displayed in dramatic expression (elementary principle: a desire to appear to be of as much importance as possible, as seen, for example, in the pheasant when he strikes a wheel before the female); in another, musical talent seems to be the result of a well-developed faculty for the retention of tone-combinations and rhythms; again, in another, music means a predilection for purely sensuous effects on the auditory sense, etc. To me it is all chaos. It pleases me to deceive myself (that is no idle dream of mine), that sometime I may be able to write something sensible concerning matters outside of my profession; and that it is only the short extent of my vacations that prevents me from developing within me some mature thoughts. I like to think this, I say, although I am well aware that it is a delusion. Similarly, in my chosen profession, I have only given the incentive, have acted only as pioneer and blaster; as soon, however, as the ground was cleared, the road made, the

blasting done, I gladly let others do the sowing and harvest the results.

In a letter of September, 1890, Billroth again refers to his undertaking:

Your kind encouragement has finally begun to bring about a realization of ideas which have occupied my mind for years. I am now writing an essay: Anatomical-physiological aphorisms about music. Who is musical? It is to form one of a number of essays (which I think of publishing together under the title "Reflections of an Abirsee-promenader") providing that they turn out to my satisfaction. At present matters are beginning to swell like Faust's poodle behind the stove, and I am afraid that the book will represent only the lucubrations of a vagrant pedant. It supplies me, however, with a fund of pleasure; whether it will do this for others is, of course, a question of another kind.

One year later, in September, 1891, Billroth wrote from St. Gilgen:

About a year ago, here in Abbazia, I wrote a fairly large manuscript—"Aphorisms on the anatomy and psycho-physiology of musical matters." It remained untouched for a whole year; I have now taken it up again. The first chapter, "Concerning rhythm as one of the most important elementary principles of music, and one most intimately connected with the human organism," was fairly satisfactory to my critical judgment, so that I made a fair copy of it. The beginning of the second chapter also, "Concerning the relation of pitch to the human organism," seemed good. But after that consideration other kinds arose—speech, song, vowels, harmonics. I began to question the accuracy of some of my statements. This led me to read Helmholtz, which I did at first only cursorily, but after taking up Landois' book on "Voices of Animals," I came back again to the former. I used the fourth edition, which contains much new matter as compared with the first which I had studied years ago. A consideration of vowels, harmonics, speech, etc., brought me into the sphere of psychology—concerning the evolution of speech and song in the child—and in this way to Preyer's highly important, somewhat voluminous, but nevertheless interesting treatise. I really do not intend to write anything of a learned nature, but wish to clear away false notions about such matters from the minds of amateurs. Is the process of composing intimately related with the phenomena of hallucinations or illusions? This forced me to resort to a book on hallucinations, sleep, dreams, etc.; indeed, it led me to a study of mental diseases. I do not care to write a line which might convey the least uncertainty about such matters, nor to use a single word in an erroneous or equivocal manner. . . . Now I have certainly read so much of real excellence, that, for the present at least, I am too timid to look at my manuscript. You can see that I am not destined to become a popular writer. I readily pass over inaccuracies on the part of others so long as the authors interest me; but every statement of my own I weigh with intense seriousness. Thus my contemplated essay can hardly expect to ever become a realization. No matter! If such a work is ever needed, it will be written by some one else. What is occupying the mind of one person at any given time is receiving the attention of hundreds of others.

At last, November 21, 1891, Billroth sent Hanslick a part of his essay together with the following letter:

Although you have often encouraged me to commit to writing various of my views on music, expressed in conversation at one time or another, it is with some feeling of anxiety that I send the enclosed manuscript. If you will read it at your convenience,

you will please me very much. I have written down these ideas partly because I wished to be better able to form an opinion of their real meaning, and partly from the mere pleasure of producing something. But I do not intend, at least for a long time to come, to hand them over to publication. While writing I have kept before my mind the needs of a fairly educated public, but have earnestly endeavored to avoid medical or philosophical cant. In the first two chapters sent you, I think that everything has been gone over which might be designated as "Musical Physiology," or "The Physiology of Things Musical." The remainder is based on conventions. But inasmuch as convention depends on the psychology of the human being with respect to his position as to social or gregarious animal (*See Darwin*), and on psycho-physiology—because of the inseparability of the soul and body—the following portions of this work may be considered appropriate so far as regards the main title.

It is interesting to observe in a man of Billroth's reputation that shy modesty, in connection with his work, displayed—in various letters to Hanslick—such a diffidence as regards his knowledge and style. It must have been a fear lest he should write too learnedly or as a pedant that induced him at first to prefix to a number of chapters musically humorous headings, viz.: I. Marcia (like a march); II. Allegro serio, ma non troppo (at a not too serious gait); III. Grave (with gravity); IV. Thema con variazioni (theme and variations); V. Serenata (serenade); VI. Intermezzo (interlude); VII. Finale tempo giusto (conclusion at a good gait). These headings, present in his first sketch, he afterwards changed. The title "Who is musical?" was originally prefixed only to the last chapter. It was finally, but perhaps less appropriately on account of its limited meaning, selected as a title for the entire work.

Shortly after Billroth's death at Abbazia, on February 6, 1894, his son-in-law, Dr. Otto Gottlieb, brought to Hanslick the somewhat voluminous manuscript on the cover of which was written in bold script the following: "This manuscript is to be handed to my dear friend Ed. Hanslick, to be disposed of as he deems fit.

Abbazia, February 3, 1894.

TH. BILLROTH."

The first three chapters appeared in "Die Deutsche Rundschau"; the complete work was not published until the fall of 1895. In a prefatory note Hanslick says: "In his manuscript Billroth designated the first two chapters as finished. The later ones demanded a more careful revision on the part of the editor because of the many illegible corrections, supplementary remarks, and inserted additions. I have tried scrupulously to avoid interfering with Billroth's mode of thought, and style, and have therefore confined myself to making only insignificant changes in some expressions and in removing many needless repetitions.

"The last chapters, although not so polished as the first ones characterized by Billroth as 'finished,' are not less important and rich in content; in fact, they possess for my emotional sense a somewhat unique, and indeed a greater charm, owing to their informal freshness, which is suggestive of a personal discourse."

#### THEMES FROM "WER IST MUSIKALISCH?" OR PSYCHO-PHYSIOLOGICAL APHORISMS ON MUSIC.

Billroth's work is an attempt to fill a gap that exists in the literature of acoustics, and of esthetics. Helmholtz, in his "Sensations of Tone," attempted to connect the boundaries of two sciences—physical and physiological acoustics on the one side and esthetics on the other—which, although drawn toward each other by many natural affinities, had before his time remained practically distinct. Works on physical and physiological acoustics are by no means rare, and of those dealing with esthetics, pure and simple, there is an abundance. Ed. Hanslick, has ably covered the ground of musical esthetics in his book "On the Beautiful Music" (*Ueber das musikalisch Schöne*). Billroth makes a modest and largely successful effort to construct a road through the almost unknown territory of the purely psychological in music. The book, as edited by Ed. Hanslick, is called "Wer ist musikalisch?" the title being that given by Billroth to the last chapter in the book, and designated by him as a sketch. The selection does not seem to me a very happy one, inasmuch as the title by no means represents the matters treated of in the volume.

The book contains some 250 pages, and is divided into seven chapters. The first treats of rhythm, an essential element in music, which is intimately associated with our organism. Nearly all human beings and many animals are agreeably moved by repetition of rhythm. Human beings feel induced to execute similar rhythmic movements with their body, particularly with the head and hands. This may be explained on the ground that the movement felt as a rhythm acts upon certain properties of our body, which are known to us from experience and to which we are accustomed by practice and exercise, so that the perception of a rhythm may be transformed without reflection into a rhythmical movement.

Rhythmic movements are among the most important properties of our body, and are necessary to life. Thus for instance, we have rhythmic movements of respiration, rhythmic movements of the heart, and the rhythm which we are capable of imparting to our voluntary muscular movements. It is probable that all muscular movements of the body, conscious or unconscious, are brought about by a summation of numerous infinitesimal and imperceptible rhythms.

The psychic contagiousness or power to cause imitation which rhythm exercises upon human beings is well known. The psycho-physiological law of sympathetic movements and sympathetic sensations (*Mitbewegung und Mitempfindung*) has such a wide distribution in the animal world, and is of such eminent significance for our entire social and ethical culture that it gives the impression of a fundamental natural law applying to all organized matter. The effect exercised by human beings upon one another is based upon it. When Billroth speaks of sympathetic movements and sympathetic sensations as the results of a transference of psychic and physical rhythm, he has mainly in view the transference of a



movement or sensation, through observation by the senses, from one individual to another. Speaking purely physiologically, sympathetic movement is often used to describe the transference of excitation from one motor nerve to another, and sympathetic sensation would mean the transference from one sensory nerve to another. This latter conception has little bearing upon Billroth's consideration of rhythm.

It would lead me too far to enter upon a consideration of the powerful social consequences of sympathetic movement and sympathetic sensation, in which we must, according to Billroth, recognize one of the strongest foundations of ethics. He next considers the tendency to appreciate rhythmic movements as it is continuously impressed upon us by observation of our fellow creatures, men and animals. In an entertaining manner the rhythms of the movements of a horse are described. The walk is compared to the *Andante* (2/4), the trot to the *Allegro* (2/4), the gallop to the *Allegro con brio* (3/8), with a 1/16 up-beat (*Auftakt*), the canter (*Presto* 2/4). The description of the rhythms in the walk of hens is almost comical, while the recognition of those hidden in the call of the cuckoo, of the quail, and of the cock, shows an analytic and careful observer.

Billroth asserts that a fundamental condition of music, viz.: the more or less conscious ability to receive and appreciate rhythmic movements, must be innate in man and many animals. This question is intimately associated with the problem whether the aspects of time and space are also innate with us, *a priori*, in the sense of Kant. Billroth's opinion is that these capacities are born in us, but they can only become conceptions by experience. The perception of rhythmic movements occurs with varying intensity in different individuals, and it may or may not lead to sympathetic movements. The event will depend upon the power of observation and experience on the one hand, and, on the other upon the greater or lesser irritability of the nervous organs, and also upon the degree to which excitation can be transferred from the tracts of special sense to the motor paths. The quicker or slower propagation of nerve excitation, is a quality that may be innate, or may be developed by custom. Every one has noticed the difference between vivacious and phlegmatic temperaments. Most European nations, particularly the Romance South Germanic, and South Slavic tribes, are in general of a quick, vivacious disposition, and love this temperament in other men; whereas the inhabitants of the North, as well as the Oriental nations, have a quiet temperament, and give preference to this also in other people. Of course there are individual exceptions. Religion and custom in certain great tribes have in a few instances idolized the acquisition of the greatest possible indifference in temperament, including not only the suppression of every individual emotion, but the encouragement of the greatest possible independence from surrounding stimulations. Similar principles, according to Billroth, constitute the highest ideal of human perfection in the education of the English nation. The freest and the most perfect individual is the one who can appear independent of all external influences, like a

rock in a stormy sea. To be moved or to show emotion under the influence of environment means to become ridiculous; such Billroth conceives to be the force of English custom. Inquisitiveness and the pleasure caused by changes in the external environments, are not totally excluded, only there must be no expression of this sensation. This is an Oriental trait. Whilst the powerful significance of such innate and acquired peculiarities of character are not to be underestimated for practical life, nevertheless, so far as the appreciation of music is concerned, such men are wanting in the most fundamental requisite. Individuals who have no perception of joy or pleasure resulting from sympathetic sensations or sympathetic movements, and in whom the expression of any possible joy has been gradually deadened by education, must of necessity become unmusical.

It is a commonly accepted view among the laity that the feeling for rhythm is innate in every man. Billroth disproves this idea by a number of statistics from Austrian and Hungarian regiments indicating that in some regiments there are recruits, amounting to 2 per cent of the total number, who never learn to march rhythmically. These men are not permitted to appear in the parades, or are transferred to cavalry regiments. Besides these there are always about 20 to 30 per cent of recruits coming from Roumania and Bosnia, the mountainous countries, who remain awkward; sometimes they imagine they march well, and are surprised when they are criticised. In a Polish regiment there were to be found soldiers who had served 10 or 12 years, and who nevertheless could not march rhythmically. Some of them would march passably well when they were in the ranks, where they could watch the feet of other soldiers and be guided by their eye, but they could not march by themselves. It is therefore correct to assume, that the rhythmical feeling is not innate in all human beings, and that there are some who cannot even be taught to appreciate rhythm. They must be absolutely unmusical, for the ability to apprehend the rhythmic organization of tones into a melody is the fundamental and first condition for the comprehension of music. The popularity as well as the longevity of certain music, depends far more upon the rhythmic, than upon the melodic property. All the songs of the people are constructed in a very simple rhythm. The rhythm of a melody, in order to be popular, must not only be short and simple, but must frequently be repeated in the same manner.

From popular songs the author turns to a consideration of popular dances; and in an interesting paragraph gives suggestive historical facts, tracing back the dances among the mountain inhabitants of Austria to those of ancient Greece. This section is of unusual interest, but can only be touched in a cursory manner. The dance is one of the oldest arts spoken of in history. Simonides calls it mute poetry. It would be interesting to know how David danced before the Ark of the Covenant; what was the step of Louis XIV in the minuet; what was the dance that Aspasia taught Socrates, and that of the guests at the banquet of Xenophon.

But to go back again, rhythm is asserted to be more im-



important for the longevity of a composition than melody, because it is the more elementary of the two, and is more intimately associated with certain fundamental properties of our body. Melody is always more or less dependent upon conventionality, upon habit, and fashion. As illustrations we may take the compositions of Händel, Marcello, Bach, and Scarlatti. The melodies of these masters appear strange to us, and their harmonies monotonous and occasionally ugly and bizarre. What has perpetuated these compositions, according to Billroth, are the incisive energy and the abundance of wonderful rhythms. Many great masters in music have lived after them, but they could not create anything more powerful and impressive than the rhythms of these composers. It seems that the creation of magnificent rhythms in music has been exhausted—a condition analogous to that as existing in drawing and painting, and in the disposition of space in architecture. Both seem to be exhausted since the productions of the masters of the renaissance period. Billroth does not consider that R. Wagner's compositions have become extensively appreciated, and what popularity this master has obtained is due to the exquisite rhythm in the beautifully-formed Wagnerian Motives. The endurance of Meyerbeer's four great operas is attributed principally to the great care that had been bestowed upon the rhythmic development of his music. When the sensation for rhythm has entered consciousness as a pleasant perception, and when it has caused sympathetic sensations and motions, it becomes incorporated in memory, and we begin to combine and play with these inner musical conceptions. It is an interesting, fascinating, and esthetic playing of our fantasy. By playing Billroth does not mean toying or trifling, but rather the association and combination of musical memories and conceptions. We could not say, if we are conscious of such melodic and rhythmic cerebration, that we are playing, but we would have to say as the Germans

“Es spielt in uns” (It plays in us).

This playing may be a partly unconscious and a partly conscious and active process with us. Thus a philologist or a poet plays with language conceptions; a mathematician plays with numbers or geometric forms; a painter plays with visual forms and colors, and so forth. Why one individual plays more particularly with one form of conceptions, and another with others, and why in one person one group of conceptions will remain in memory, and another group be forgotten, depends in the first place upon his organization, and the inherited peculiarities of his character. In every man will be fixed those perceptions of the senses, for which he has inherited the greatest receptiveness and ability for comprehension. This play of the conceptions leads to various results and actions which will vary according to the talent and character of the individual, and according to the characteristics of the human beings into whose society he is born at a certain time.

The acuteness and distinctness of musical perception depends upon three properties of the mind, which may be partly inherited and partly acquired. These are the following:

I. *Memory for Rhythmic Forms.*—An individual who does not possess this ability, or who cannot acquire it; who cannot recognize the repeating individual rhythmic structures in a continuous composition; who, for instance, has forgotten the beginning of a musical sentence at the end of the same, is not capable of the perception of genuine pleasure at the hearing of complicated rhythmic combinations.

II. *Pleasure at the Change of Conceptions.*—This capacity, which is peculiar to man, and in animals possibly occurs only in the highly intelligent that are in constant association with man, is inactive in indolent human beings.

III. *Pleasure at the Increase of Conceptions, and the Augmentation of Memory. Pleasure at Overcoming Difficulties.*—There can be no doubt about the elementary significance of rhythms, and the arrangement of modern music into measures, when one reflects that the attractive and charming cooperation of several instruments or several voices is inconceivable without rhythm and measured arrangement. The effect of various rhythms in causing certain sensations and conceptions, is of interest. A rhythm that we hear, or a rhythmic motion which we see, may cause a direct sympathetic movement in us. For example, we begin to beat the time with the hand when we hear music, or we feel induced to imitate a rhythmic movement which we see others execute; but the same sources of excitation may cause other conceptions by association; such for instance, as may have been deposited in our memory on former occasions by or simultaneously with that particular rhythm. For instance, dance or funeral music may remind us of a joyful dance or of a sad funeral. There may even be recalled to memory conceptions of certain persons, whom we met at the dance or at the funeral. All at once a definite landscape, a hall, a room, or the inside of a church with all its detail, may appear before our mind's eye, and we may be moved by the identical sensation that filled us when we heard similar music and the same rhythm for the first time.

Rhythm may effect an accelerating and inhibiting influence upon the psychic movement, the frame of mind in which we are momentarily. This leads the author to the question whether rhythmic movements alone—simply as such—are capable of expressing or communicating anything. This of course is associated with the question whether music without words can express ideas. That this is possible to a high degree, is evident, and an analogy is found in the so-called language by gestures. Rhythms may be perceived simultaneously by three senses. They may be heard, seen, and felt in our muscles. Now, as the influence on consciousness may be exerted from three senses at the same time, it is evident that the major part of our nervous system is occupied in the process—a fact which readily explains the marked effect exerted upon the entire organism. The relation of rhythm to several senses simultaneously has been described by Aristides.<sup>2</sup>

Billroth next compares rhythm in motion with rhythm at rest—*symmetry*. Moving rhythm is the arrangement or disposition of time, while symmetry is an arrangement and or-

<sup>2</sup> Westphal, Griechische Rhythmik, page 47.

ganization of space. This close connection with thoughts on the rhythm and harmony, as expressed in painting, sculpture, and architecture, explains the author's inquiry as to whether the perceptions of rhythm and those of time and space are innate (in the sense of Kant).

In the third chapter, an abstract of which follows, Billroth deals with the development of the musical with the science of music.

The term Physiology (Natural Philosophy, Physiology of Man, the science of dealing with the functions of the human organism), in recent times, has often been employed in popu-

pear to most people as distinct, separated from the body. This I find very natural! The entire development of the civilization of mankind, its power, though limited, over many forces of nature, the comparative comfort of the ruling classes in the social divisions created by themselves, have not developed from the purely physiological, physical struggle for existence, but are victories which, especially in historic times, have been won principally with psychic weapons that are continually being forged in the smithy of the human brain. We cannot, therefore, be astonished that the psychic appears to the man who has not received an



1867



1892

lar works in connection with matters that refer far more to culture than to nature;<sup>4</sup> whence has arisen much confusion concerning the character of the "original" or "natural," and its relation to the acquired or artificial. On this account I consider it necessary to explain here that we, with what has been previously said (in the first and second chapters), are at the end of our purely physiological considerations, in so far as they are related to music, indeed, that we have already crossed its boundaries here and there and touched upon the domain that has been acquired by purely psychological work.

The soul (*Psyche*), according to the views of the present time, is not to be separated from the body, and the phenomena in its domain, therefore, form a very essential part of physiology. Nevertheless these phenomena ap-

pear to most people as something distinct, higher, separated from and controlling the brute force of the body.

And yet the soul is more dependent upon the body than the body upon the soul. What we call perception, thought, conception, consciousness, could come into existence in the absence of a brain. To be sure, there exist, not only in the lower animals but also in man, unconscious bodily sensations and bodily motions (reflex motions) which take place without the so-called psychic phenomena, as in a well-constructed machine.

It seems not only inadvisable, but, in the present condition of society even absolutely harmful that in popular works so much stress is laid upon the dependence of the soul, because the constraint of the will is naturally connected with it. To such a degree does the entire structure of human society rest on the social dogma of the freedom of the will and on the consequent responsibility of the individual for his actions, that the beautiful edifice would be shaken to its foundations if

<sup>4</sup> *Physiology of the Social Body* (Schaffter, de Lass, Strümpfer), of Love, of Hate, of Marriage, etc. (Balzac, Stendhal, Mantegazza, Bourget).

everybody were to maintain that all his thoughts and actions were nothing but the result of phenomena in his body, conditioned by his individual bodily constitution, his inborn psycho-physical character, for which he could be made responsible as little as for his existence. Indeed, as one of its great aims modern investigation has set itself the task of explaining the development of all ethics, as well as the rise of religions, as purely psycho-physic necessities, and as the natural consequences of the structure and composition of the human organism. But even if we were beyond the very first beginnings on this path, I should consider it dangerous, as yet, to practical ethics, to raise the veil from these mysteries of our temple of sciences before the populace.

Without going further into these and similar considerations, let it suffice to say here that the term "psycho-physic" or "psycho-physiological," as used at present, is applied not only to the connection of the qualities of body and soul but also to the treatment of psychology by means of physiological methods. If, therefore, that which I have still to say about the "Musical" does not belong to the domain of the purely physiological, it nevertheless is included under that of the psycho-physiological. I will go still further and put the results, due to social forces, of certain concessions and concessions in the domain of the musical, the "conventional"—also in the domain of the psycho-physiological.

"Conventional" and "natural" are in a certain sense antitheses. But to simply identify conventional with unnatural is in itself wrong. No creature can do anything that is not made possible for him by his natural organization; the unnatural cannot at any time be acted or even thought by man; for man cannot think anything else but what the nature and organization of his brain allow him to think. The conventional is the natural result of human striving toward conditions that bring advantages and give pleasure; it is one of the results of and at the same time one of the conditions underlying the existence and advancement of human society; it is not imposed upon society by tyrants, heroes or gods, but imposes itself, just as law and custom, and like these, it varies in its practical consequences according to place and time. The formal development of the conventional requires, to be sure, one, sometimes more, personages; these are the typical expressions, to a certain degree the embodiment of a determination or will of society (*Gesellschaftswillen*) or of the people (*Volkswillen*) in a certain time—a determination which has not yet come to a definite expression. They become leaders, lawgivers, heroes, and to us, if the mental tendencies of a long past form of society are not well enough known to us, they may appear as arbitrary tyrants, although in reality they were the slaves of the spirit and the will of their times. The same holds true for the rise of fashions; the need of society for change arises from a similar need in the individual; attempts are made by this man or that man to take the lead; whoever finally strikes the taste of the majority becomes leader. "Fashionable" and "Conventional" are terms for the same psycho-physiological processes in the

organism of human society. *In this sense the conventional also belongs to the nature of man and of human society.*

After these explanations of terms to be used later on, let us return to the "Musical."

It is justifiable to assume that the feeling for rhythm and the power of perceiving differences in tone pitch, tone sound and tone strength, as well as the capacity of differentiating these qualities in rapid change and combination are the physiological prerequisites for what we now call musical. Nevertheless, that everybody who has these qualities, is *ipso facto*, according to the customary use of language, to be called "musical" must be unconditionally denied. Does every man, unless he has been born absolutely deaf, possess the aforesaid psycho-physic qualities? This question cannot at once be answered in the affirmative. We cannot observe the inner phenomena of another man directly, but only deduce them indirectly from his physical utterances, especially from his reflex motions or his motions of accompaniment or imitation.

If we take as a standard for the rhythmic sensibility of a man his ability to correctly accompany seen or heard rhythmic movements, or to imitate them, we should occasionally, although seldom amongst civilized peoples, find persons apparently incapable (refractory) in this respect. As was pointed out above there are men whom it is impossible, or at least very difficult, to get to march or to dance in rhythm. This may be based on awkwardness. One of the most remarkable examples was Beethoven: eminently successful as he was as pianist, he is said never to have succeeded in dancing in time. It is also said of the singer Malibran that it was impossible to dance with her, because she did not keep time; and yet she was very fond of dancing. In both cases the defect could hardly have been entirely due to the lack of the feeling of rhythm; it could certainly have been obviated with some practice, unless it arose from a kind of shyness to exhibit one's self before others. This, indeed, is very difficult to remove.

Much more frequently we meet with people who find it impossible to repeat accurately a tone that has just been sung, and who claim that they do not perceive intervals of quarter tones or even half tones, even when sounded together. A false note in an opera, since but few concentrate their attention entirely or largely on the music, is probably noticed by hardly a fourth of the audience; the tremolo of the singers by a much smaller part of the hearers still. A not quite accurate reproduction of a tone, so frequent, especially among beginners in vocal music, is not always a proof that the person singing incorrectly is unmusical; often it is only the result of inattentive listening and of an awkwardness in the motions of the laryngeal muscles, and can be removed as soon as the ability to perceive the impurity of the tone exists at all or can be awakened from its slumber. Singing incorrectly on the part of trained musical singers, especially on the stage, is principally due to psychic causes—excitement, fright, and also overexertion. Most people probably distinguish whether a tone is strong or weak and whether it is produced by an



oboe, a violin or a human voice. But there are individuals who seem to have no conscious sensation even for greater tone intervals, indeed even when one tone is relatively much higher or lower; they think they are imitating a song correctly when they reproduce its rhythm alone, and with it arbitrarily use first one tone, then another, or always the same. These persons, to be sure, are hopeless cases so far as regards a musical education; and yet they may be passionately fond of music with a kind of childish delight in rhythm and combinations of tones as such, just as other people take delight in brilliant colors without being in the least endowed with the artistic sense.

It is only since the appearance of the epoch-making book of Helmholtz that musical physiologists, psychologists and specialists in ear diseases (Preyer, Stumpf, Politzer, Urbantschitsch, and others) in the last decade have busied themselves in determining with greater accuracy the physiological and psychological foundations of tone sensations and tone combinations and their closer relation to the music of our era. As a result of their studies very remarkable facts have been brought to light, showing on the one hand how widely the power of distinguishing tone intervals varies in different persons, and on the other hand how much may be obtained by systematic practice, even in the case of deaf-mutes (Urbantschitsch). It would lead us too far into details to treat this more fully. Suffice it to say, that the cause is to be found more rarely in corporeal defects (consequently defective or partially destroyed organs), in the auditory apparatus than in defective afferent nerve impulses and faulty attention to complicated sound impressions. Indeed, there exists a total psychic indifference toward all sound perception, especially toward all combinations of sounds, which might be termed a harmonic nihilism, a harmonic deafness. A friend of mine, who enjoys songs, and occasionally goes with his wife to a concert, is without any perception of the agreeable or disagreeable in the combination of tones. He forms the same impression on hearing a chord of three sounds that he does when he hears five neighboring tones struck at the same time. Thus, when I played for him the air "Wir winden dir den Jungfernkranz" in F sharp major on the piano, and accompanied it in F major with the left hand; he said, "That is from 'Der Freischütz.'" I repeated the F accompaniment with the left hand and played the air in G major. I asked "Do you notice any difference?" He reflected a while and said: "I believe it pleased me better the first time."

To appreciate the fact that in a large concert hall there are a hundred or more auditors who stand on this same plane, and that there are many more to whom all variations up to a third sound as one and the same tone, so that for them there are at the most only four well-defined tones in an octave, and that for these there does not exist any incorrect playing or singing at all, must certainly cause a somewhat gruesome feeling in the mind of the artists—"Love's Labor Lost." But during the thundering applause, the musically deaf probably clap more violently than the really musical. In my

friend there was really a musical force present, that is to say, the memory for the rhythmic: he recognized the air as taken from the "Freischütz." But even this memory may be wanting and yet the individual may play the piano. A young girl who had taken lessons on the piano for two years, was practicing a piece of Mozart's, and was ready to play it for her teacher. She came somewhat late and found him sitting at the piano and playing. In order to make her presence known she asked: "What are you playing there?" The teacher turned around astounded and said: "Why, that is the piece you are to play for me to-day." "Indeed!" She then played the piece faultlessly and the instruction was continued. This lady married a very musical man. Of their three sons, all very intelligent, two are absolutely unmusical, the middle one is exceedingly musical. To give another example of an apparently unmusical person: A very musical couple had a son who seemed, when a small child, not to take any interest in music. When he was about eight years old, his mother would sing airs for him, which he, however, could not repeat; nor could he sing a note struck for him on the piano. His mother consequently considered him totally unmusical. When he was about twelve years old, he came now and then when his mother played the piano and said: "That is pretty, mama." As time went on he could sing and play correctly melodies which he had heard, and later became anxious to learn to play the violin. In this case there was a small degree of attention to sound-impressions during earliest childhood, together with awkwardness in reproducing with the laryngeal muscles the sound heard, which in turn gave rise to a sort of shyness, from fear of making himself ridiculous by unsuccessful attempts.

These three examples from my latest experience (I formerly gave the matter no particular attention) show how manifold the coefficients are which determine whether a man is musical or not musical.

I should prefer to call them, along with the aforesaid rhythm defects, tone interval defects. It is to be hoped that both are the same, for otherwise the number of the non-musical would be frightfully large, especially if the only slightly musical be also added to it, those, I mean, who are born with an appreciation of rhythm and a perception of the smallest intervals but who have no memory for music (for two successive bars) and for whom music as such has so little interest that they find absolutely no enjoyment in directing their attention to the succession of tones. Nevertheless, these persons occasionally remember airs and sing them tolerably well.

"Who then is musical?" The answer to this, apparently so simple a question, is very difficult and extremely involved, because the term music is used just as well for the beating of a tambourine as for the most complicated polyphonic vocal music. Any one who tries to answer the question must of course consider himself musical, otherwise he certainly would not make the attempt. But here there can exist self-deception, for not infrequently we hear people talking of things concerning which they know nothing and yet think they know much. I must leave it to the reader whether he holds me to

be musical and to what degree he will admit my right to give a verdict.

The concept "Music" has, as said before, become very complicated. There are various degrees (I might almost say kinds) of being musical, because the science of tones is composed of different elements, of the rhythmic, the melodious, and the harmonious, and in each of these elements there is again a purely technical and a purely esthetic element. A person may have more talent, interest and responsiveness for one than for another of these elements, just as those with talents for the pictorial arts may have more interest and talent for drawing, or for artistic composition, (lines) for coloring, or for the purely technical. The longer one ponders over the matter, the more complicated becomes that which we now call "Music," and I can only venture the bold attempt, to answer this question, after I have tried to make it clear *how that which we now call music or the science of tones arose, and how this science affects us.* Herein I am only following a scientific tendency of our age, in which we try to understand all that is about us and in us, from its origin, and which only bows down before the "inherited" or "in-born," or in other words the "marvelous" when we can get no further on in our attempts to comprehend with our sensations, observations and thoughts, the phenomena in Nature and round about us in human society. This limit is, to be sure, reached soon enough. Nevertheless, these attempts are the sole sources of that which can create new knowledge for us, and we ought not to be discouraged at the slight result of our work, which when compared with the whole, it must be confessed, is very small. "There seems to me to be no warrant that our understanding must necessarily conquer *everything* which can exist on earth."<sup>1</sup>

Every creature devotes its attention primarily to those sense perceptions and performs those movements which afford it an advantage in the struggle for existence, or cause a pleasant sensation (a feeling of pleasure).

The first cry of a new-born child is a purely physiological, a so-called reflex action, which reaches consciousness just as little as the first perception of the senses and of motion. It is only with the gradually developing consciousness, with the rise of the personal feeling (ego) that perception begins; the differentiation of sensations is made consciously; the attention is directed to single ones of these sensations; these are lifted up into the inner aspect, and finally there results apperception. The child, through its muscular sensations (that is through the sensations of tension, of contraction and of laxity of its muscles), gradually reaches a consciousness that certain processes within itself are connected with certain muscular motions; it then tries to call these muscular motions forth by means of images from its memory. When this is done successfully the first conception of

causality has developed in the little cosmopolitan, the steps being in the following order: Sensation, perception, differentiation, conception, will and motion—all arising out of experience. The child begins to carry out conscious movements; for instance, to cry intentionally. This has for it a quickly apparent result: as a consequence of its crying it is nursed, and now experiences the highest pleasurable sensation which it has as yet learned to know. At the same time its conception of causality has greatly expanded; the association of its concepts and its movements has led it to this conclusion: "If I cry, I am suckled." Its logic is about to develop.

Meanwhile the child hears not only the sounds which it produces itself, but soon also distinguishes different kinds produced by others. It soon learns to know the different pitches in which people speak, and soon recognizes the different tone-colors of voices. If its attention has once been directed toward the differences of these sensations, it tries to produce these variations for itself, which can only be done by means of different muscular movements, which are experienced by it. It sees and imitates many such movements (mouth positions), others it discovers by means of its own attempts. It will call forth and reproduce, more especially, those movements which are pleasurable or useful to it.

If we leave the nursery and try to imagine grown-up men in the primeval condition of intercourse, we may well take it for granted that they soon discovered how much sounds, that were produced consciously and intentionally in different pitches and timbre, assisted communication by means of visible gestures of the entire body or parts thereof. The more man became conscious of the extraordinary power of modulation of his voice by means of the play of manifold, empirically discovered movements of the mouth, tongue and gums (naturally without having the least idea of the physiological and physical processes involved) and the greater the practical benefit which he learned to draw from it as a social creature, ("political animal," Aristotle), the more he developed these "sound gestures," that is, spoken language, and in the course of time used it even predominantly for communication, and neglected the further development of speech by means of visible gestures of the other parts of the body. The visible gestures of the entire body, which even now form the principal means of intercommunication of animals, are used by civilized man only as an adjunct to speech, although among some nations (for instance, the Italians), they are still very largely used. They fall into entire disuse with the introduction of the written language as a means of communication, which, owing to the acquired necessity of connecting certain sound images with certain definite symbols, can call forth within us any desired circle of representations (Vorstellungskreis), in the same manner as the objective perception of gesture and sounds. Next to speech itself, writing is probably the greatest invention of the brain of the "political animal," because it is practically the most full of meaning.

*Without the ability to perceive and produce different sounds*

<sup>1</sup>Helmholtz had two classes of critics of his *Sensations of Tone*: (1) Psychology objected to reduction of esthetics and emotion to physical cases. (2) Physicists and mathematicians claimed he had not gone far enough in explanation of physical cases.



*in different pitches, the development of human speech would have been impossible.*

Would not, however, the ability to distinguish and produce only different pitches have sufficed to form a pure tone-language? Would this not have been possible with even one tone alone? This cannot be doubted. Such a language might have been formed somewhat like the telegraph code, which consists only of different combinations of dots and dashes (shorter and longer tones); and if we imagine these dots and dashes to be variously colored (different pitches) then we would have at our disposal a richer supply of expressions. One could use in this way acute and grave tones, rhythmically combined, for the development of a tone-language, without any participation of the mouth, the tongue or the gums, that is, without the simultaneous use of different tone-colors. But such a proposition appears to me just like asking whether man, if possessed of only one leg and two arms, or of two legs and one arm, could have attained the same completeness of social development as with his present shape. The fact simply is, that he has four extremities, of which the rear ones are much stronger and longer than the front ones; therefore, he walks most comfortably upright and develops his arms and hands for all sorts of useful and pleasurable purposes. Thus man has an oral cavity which allows very great changes in form. This capacity is lacking in the majority of the higher animals, since their oral orifices reach nearly back to the rear teeth, and on this account the formation of the various vowels as well as most of the consonants is impossible for them. Man has an exceedingly flexible tongue; he has the ability to cut off the connection between the mouth and the nasal passages by means of the velum, and by means of experiments and experience he has learned not only to produce with this complex apparatus the manifold modulations of the tones of his larynx, but also to render the distinctions clear. It was more convenient for him to use this apparatus for coloring tones, employing few changes of the tones of his voice, than to develop the latter into a pure tone-language. We speak more easily than we sing, because speaking interferes much less with the breathing process than singing, and also because the laryngeal muscles tire more easily than the muscles of the oral cavity, etc. A singing in quick, short rhythmic movements (dots and dashes) such as would be requisite for a pure tone language, if the latter were to have a completeness even approaching our present tone-color language (Klangfarbensprache), would bring us so often in collision with our breathing-rhythm that the effort would become a torture for us.\* Man could, if he were compelled, by means of continuous practice, even in this direction perform wonders; indeed he could get so accustomed to

the system that he would no longer experience its discomforts. If such a style of speech were to become the fashion, who knows what would happen!

It is still a long way from speech to song and thence to music, and yet, according to my conviction, song (even if not all music), developed out of speech. I imagine the process to have been somewhat as follows:

To the original "sound-gestures" belong especially the words of address, exclamations and interjections. Tones, lasting for a longer or a shorter period, are uttered strongly and repeatedly, as the mimical expression in sound (klangmimischer Ausdruck) of a condition of sensation. This probably was, in the beginning, a purely reflex process, analogous to the cry of the new-born child, but soon became a consciously used, useful means of expression. In very loud speaking, in the public, loud praying of priests it was found especially effective with the audience, to at one time raise the tone of the voice, at another to lower it; possibly this was not at first intentional and occurred as a natural result of the exertion and fatigue of the laryngeal muscles. Most people end a sentence with a lower tone than that with which they started—a tone-falling or cadence. To emphasize single, especially important, words, the voice was raised to a higher plane; by this means the speaker succeeded better in retaining the attention of the hearers than by talking in a monotone pure and simple. The more strongly breathed word becomes somewhat higher, just as the gas jet becomes brighter on account of the stronger pressure in the service-pipes. Stronger intonation is at the same time unintentional tone-elevation; but the speaker also often goes to a higher level; the orator intentionally uses different tone-elevations; his speech is, by the side of sound-gesture, also tone-language. In ordinary conversation we keep probably within a fifth; in excited discourse we probably use an octave. These aids to expression were probably used more especially by priests, seers, prophets, orators and narrators; they simply proved to be useful for the attainment of the desired effects. From such a pathetic way of speaking to a half-singing reciting is an easy step, and finally a scarcely noticeable transition. Soon the priests prayed almost altogether in a singing tone. This custom came over from the Greeks and the Jews into the Christian Church, and was there developed in several directions. In all these cases the singing tone serves only as a practically useful strengthening of the expression. The tones of speaking still rule over the tones of singing.



Tones and words, when they are both connected in similar rhythmic members, approach more nearly what we at present call vocal music. Herein also one of the most important factors of music is developed—a *division of tones into a definite succession of intervals*. In ordinary speech one can let the tones of the voice run into one another without becoming actually indistinct; the thorough comprehension of a verse rhythm requires more sharply differentiated tone intervals. Finally, the verse brings with it the most important element for the form of music—the repetition of the same or similar, larger or smaller rhythmically formed parts. The single

\* The birds have predominantly a tone language. The parrot, on account of his thick, very flexible tongue and the shape of his relatively short oral cavity, is qualified, physiologically, for human tone-color speech, and intelligent animals of this kind can, it is well known, be trained to repeat words of the human language, as well as to imitate human whistling in various pitches.



verse foot resembles a musical bar, the verse line (stichos) the melody-air, or "motive"; a group of verse lines resemble a "melody," or a "Melos" in the Greek sense of the word. The verses, when sung, give rise to regularity and order in the world of tones. *From the linking together of a succession of tone intervals, and of rhythm, in the narrower and the wider sense of the word, the science of tones—that which we now call "Music"—was born. With its release from these bonds it dies as a science.*

Aristoxenus long ago made very apt observations about spoken and song rhythm. He says, according to Westphal: "In declaimed poetry, we, to be sure, experience strongly the difference between the rise and fall (thesis and arsis) of the verse foot; but it is very difficult here, perhaps impossible, to assign a definite space of time to these two periods; we are satisfied if the period allows us to note a certain number of accents (ictus); how long or how briefly one dwells on the enunciation thereof does not concern us; we take the privilege, and see in it just the advantage of a well-expressed style of declaiming, of resting longer on such syllables, which are especially important for the logical sense, irrespective of the fact whether it is done by a longer-continuing enunciation or by pauses; and it is also a matter of indifference at what these pauses occur; whether at the end of the colon (verse foot) or within the colon and the verse foot. (One sees from this that already in the delivery of Greek poems that were not sung, particular attention was not always devoted to the length and shortness of syllables, upon which Greek metrics are founded. Note of Hanslick.)

"In music, however, the duration of the arses and theses are subject to a definite measure of time, and likewise the pauses occurring here are integral parts of the rhythm. By the symbols — — we understand that the second syllable is half as long as the first, accordingly — — =  or . They have no absolute value. (Except when they are determined by the metronome. Note of editor.) The values of the rhythm, assumed at the beginning of a piece, in music remain the same; in declamation, on the other hand, they may be changed at pleasure. In the rendition of songs, the change in time of the smallest parts of a bar (of the Chronos protos) has become almost the rule; it is just through this that this kind of vocal music approaches speech; but the musical rhythm must never be neglected to such an extent that it becomes incomprehensible to the listener. Herein much depends upon the art of the singer. The free instrumental 'performance of the melody of a song' rests upon the fact that it takes liberties, just like the singer, as if it desired to play words, and thereby often scores a great effect, and makes an impression very much as does a song. Exaggeration in a performance in this direction is in bad taste; it can easily become unmusical. The so-called phrasing must, in spite of all freedom, always be simple, clear and musical, and never leave the listener in doubt as to the kind of time. Liszt, Rubinstein and Joachim were and are masters in this kind of playing. Modern music, like that of Chopin, Schumann and others, permit of a performance that gives very much more the effect of words. In the music of Bach and Händel, as well as in that of Mozart, Brahms and R. Wagner this kind of playing has an absolutely bad effect. These composers treat the composed verses metrically and musically-rhythmically with as great a degree of correctness as modern taste permits, although by this I do not mean to say that they ought to be sung according to the metronome. Every composer ought to be treated according to his style. A sensible actor does not play and speak Shakespeare in the same way as he would Dumas. Similarly, a sensible singer sings Händel differently from Massenet. He who makes the mistake, in rendering the simplest song, of

Since one can find in every history of music the representative of the so-called old musical modes or tone-scales, from the Greeks down to the Middle Ages, and their physical explanations in the classic work of Helmholtz, I shall not go further into this subject and will only add that, in my opinion, these tone-scales were only determined after they had long been in common use. The musician composed (granting indeed that this word can be employed for the old recitative music), not according to fixed tone-scales, but constructed the tone-scales from the existing compositions, which persisted principally through tradition. But doubtless the development of the language, especially the pronunciation of the vowels, had a great influence upon these. We all know that with the same laryngeal tone (Kehlkopftone) we can pronounce the various vowels, that is, we can change the tone-color of the laryngeal tone by means of modifications of the oral cavity to such a degree that of the different tones of which the laryngeal tone is composed, now this, now that higher overtone or undertone is heard to resound predominantly in unison. If this were not so, or even if it were possible only to a certain degree, one could only speak and sing the deep-sounding vowels (U, O, Au) with deep laryngeal tones, the high vowels (Ae, E, Ue, I) only with high laryngeal tones. 'In fact it is difficult to produce the deep vowels on high tones and the high vowels on deep tones, but this can be done with practice.

According as certain pure or impure vowels predominate in a language or dialect, so must certain cadences become easier for the hearers or speakers. If one determines them according to their sound, by means of notes, and brings together the tones occurring at the various intervals according to their succession of pitch (Höhenfolge) within an octave, then one gets those tones, which are used, as a scale of tones following one another—a tone-scale. It is clear that such a tone-scale must result very differently, according to the language of the people concerned (Lydian, Doric, Ionic), indeed even according to the taste of the individual. The Italians did not cling to the tone-scales, as they had come down to them from the Greeks and Romans. The Jewish Christians

laying pointed emphasis on every word and verse of the poem—effectively for the mass of a concert audience as he imagines, that is, for the unmusical or the slightly musical—often produces a musical caricature. He who performs purely musically, without much reference to the text, can give much enjoyment to the musical connoisseurs, in his singing of an aria of Händel or Mozart, but the vast majority of the audience will be entirely unresponsive, the more so, if he emphasizes or tries to emphasize also in singing songs only that which is the purely musical. To keep the true mean depends on the character of the singer, which may be somewhat changed, that is, restrained or stimulated by frequent hearing of other singers, and also by a good music teacher. But one soon learns to recognize that which has been acquired, and finally the character of the singer will reassert itself. It is given to but few to quickly find the musically correct for the largest portion of the audience, wherein the personality of the singer has a large share of the success. In a dark concert hall the judgment would be very different; the public wants to see, and especially see itself."

added new changes, so that new tone-scales kept arising, which finally were not even determined any more. The popes, Gregory the Great and Sylvester, tried to fix again the old tone-scales for Church music, as well as to determine a few newer tone-scales. Many improvements in the notation of the intervals also arose, the symbols being placed on, and between lines, instead of the books previously used. But all this did not satisfy the need for the so-called harmonious singing together, which in those days sounded pleasant; and again, the learning of the many tone-scales was very complicated. It took centuries after the introduction, by Guido d'Arezzo in 1050, of the principles of the present notation before a process was completed by which the present chromatic scale was finally developed from the old tone-scales. From this scale two tone-scales were selected which contained seven tone-intervals within the octave, and which differed from each other only by the fact that either the small or the great third (minor or major) was employed. Besides, this scale, which was composed simply of whole and half tones, in definite succession, could start from any desired one of the twelve half-tones lying within the octave; the difference consisting only in the key note (Ausgangston). All our harmony and melody rest on this system. Who discovered it? It certainly was not invented by one man, and forcibly imposed—the pope himself could not do that! It has developed out of practical need, out of convention (in the previously determined use of the term). For its determination, to be sure, experienced musicians were necessary; a certain fixed definite symbol was needed for each single tone; definite names had to be found for the modes, that is for the keynotes of the scales, definite names for raising and lowering tones, and so forth. History tells of no actual inventor of our present system of music; it has existed only for a little more than two centuries.

I mean that our present system of music, into which we are born, and which we can only with the aid of historical study imagine to be different, has developed just as gradually as our language. Luther did not invent the New High German in his Bible translation (it arose as a compromise between the South German and the Lower German or Plattdeutsch), nor did he force it upon the German nation; but he fixed it as the written language in the most important and most popular book of his time, and this language, greatly enriched by Goethe and Schiller with South German words and phrases, will presently absorb all the dialects, one after the other, simply because it is fixed; it does not on this account remain rigid, but is always absorbing new words and phrases, both from these dialects and foreign tongues, not from any intentional violence (Vergewaltigung) on the part of single writers, but from a certain ever-existing need for more exact terms to describe old and new qualities and occurrences, as well as from a need for variation in sound. We can as little imagine that our present system of tones will change as we can imagine any essential variation in our language. Music without rhythm, without melody and harmony, without a certain conventional regularity, would no

longer be for our impressions music, but a concatenation of crying, howling, raging, weeping, groaning, and rejoicing—in the form of shorter or longer interjections. It would be analogous to a relapse from the present imposing regularity to a savage condition, to individualism, to anarchy, to nihilism. Language, like music, is also a work of art; it cannot even be thought without a conventional arrangement of sentences, without a definite regularity of succession and order of the ideas that are to be expressed.

I have adduced all this to support my opinion that our modern music with its development of harmony and melody, and which, as it would seem, could only have reached its present elevation in our modern system of tones, did not develop according to anatomical-physiological laws of nature, and cannot be continued in the mathematico-physical formulas of a Laplace-like genius (Du Bois-Reymond), but arose from individual sensations and impressions and the needs of society and civilization, which, to be sure, have their origin in the important psycho-physical qualities of man and of human society. The physical representations of conditions for our present theory of harmony cannot claim to be more than mathematical attempts to explain the combinations of tones which have already been instinctively found and which affect us pleasantly (consonant) or unpleasantly (dissonant). The uncertain part of this lies in the fact that "pleasant" and "unpleasant" are just as variable qualities of sensations at different times and for different persons as, for instance, are good and bad. As it is, I cannot imagine that the sound of a major third, and still less that of a minor third, should ever have been considered an unpleasant discord (a dissonance), although many centuries ago it may possibly have had that effect on the people of that time, and as regards the number of violations of the upper partials (Schwingungsverhältnisse) expressed in numbers it ought to be so. In art, as a rule, "Whatever pleases is allowable," particularly to those who take an especial delight in the art and make it their own by means of study and practice.

As to the difference of major and minor keys, we at present usually connect with them conventionally the ideas "joyful" and "sad," having in mind, perhaps, the literal meaning of the terms themselves, "hard" (dur) and "soft" (moll). It has always seemed to me that the older dance music and love-songs of the French and other civilized nations were generally in a minor key. The minor keys also seem to me to predominate in the folk-songs of the half-civilized Slavic and Hungarian nations, although they are also used for dancing; they also occur in the monotonous songs of Oriental nations. Others have already made the same observations. This has been interpreted to mean that all uncultured nations have a melancholy temperament; that the major key is the "natural" one, partly on account of the rhythmic relations of the fundamental tones, partly on account of the unconsciously heard overtones, which make the major chord. I think this explanation is incorrect. My opinion is that it is easier and requires less exertion of the laryngeal muscles to sing the minor third or sixth than the major; even the



trained singer will admit this. Most persons talk in the minor key, and sing or scream in a major key. In all languages (the monosyllabic ones excepted), the last syllable usually drops into a minor key. When a people begins to sing, it naturally knows nothing about a scale of tones, or a mode (key). But the succession of tones of the existing song recitations must have led principally to a minor key, when tonesscales began to be fixed. Every person speaks usually in one key; in ordinary conversation I speak in D minor, in singing in D major. If I lie quietly on my back and without exertion sing a scale upwards, the following are most convenient for me as a bass-singer: D, E, F, G, A, B, C (Doric); the same hold good when going down the scale. In singing tones which on account of their height require exertion, a little more exertion does not matter; major and minor are, when high, alike in this respect. If therefore the development of the modern chromatic scale is based more on social and conventional causes, the development of major and minor and especially the latter's predominance in the beginnings of music apparently, seems to me to have more purely physiological reasons, namely, the lesser exertion of the laryngeal muscles and the relation to the cadence of words.

The development of arts and sciences, like every development, and every construction, does not proceed by leaps and bounds; every addition, every advance, is linked with something that has gone before. After the chord of three sounds was once felt by many to be one of the most agreeable of harmonies, and accepted as such, the rest developed from it in a tolerably logical order. A mathematical proof that only this trial could please, and that it alone could serve as the conclusion of a system of harmony, cannot be adduced. We can only say that man in the course of his cultural development has developed a pleasure in certain regular relations. This holds true especially for architecture, and here, to be sure, was dependent on purely physical relations, on the empirically found laws of statics. Later that which was originally necessary and useful in the relations of construction became gradually the customary, the agreeable, the beautiful. But there is a great difference between visual and auditory perceptions, and it is a bold idea to think that our organ of hearing measures the agreeable in a consonance of sounds according to the physical causes of its intervals, for instance, the intervals of the octave, as the eye measures an edifice with a standard of length. I cannot grant to acoustics such an unconditionally fundamental importance for the development of music as I accord to statics for architecture; for every combination of tones is possible, but not every kind of combination of building material. I could hardly imagine what one could urge physically and psycho-physiologically against anybody who might claim that for him the combination of C, C sharp, D, or C, D, E, or C, C sharp, D sharp, was most agreeable and was harmony, while on the contrary a triad was very disagreeable. It is only a question, how large a public there is which also feels, or claims to feel this, and which hears voices composed on the basis of these tone combinations, which to it are agreeable, with increasing and

continually spreading enthusiasm: one cannot furnish a proof that such a music is absolutely impossible and not beautiful. The majority of the public carries the day, and when it is tired of this kind of music, will follow others who offer something else. An analogy may be found in the formation of a sect, which results from the impressions and broodings of a single person, but becomes a wide-spread religion only by the number of those who join it. The impression of the one is, to be sure, a part impression of the whole (*Teilempfindung des Ganzen*) in a particular form; but why just this form in which it appears should especially please few or many of its contemporaries, cannot be demonstrated either mathematically or psycho-physiologically.

I must finally express my conviction that *the sensation of that which is harmonic is conventional, that it gradually developed in the subject, and is not originally necessary.*

The same holds good for what we now call music. I would not think of maintaining that, before the introduction of the diatonic and chromatic scales there could not have existed any harmony and melody partially agreeable for us. Both of these words are derived from the Greek and already at the time of their first use denoted certain combinations and successions of tones which were agreeable to the ear. It is probably doubtful, however, if we should experience as a pleasant succession of sounds at the present day, all that which the Greeks called melodious (from *melos*, song). The same holds true of the music of the Middle Ages. Indeed, many of the Protestant chorals, fixed by Luther, intended to be sung by the congregation, and often taken from worldly folk-songs, now hardly give us a melodious impression, nor do the words strike us as poetical. The memory of childhood and of the impressions which the Protestant order of worship made upon the youthful mind, is necessary for a warm appreciation of many of these chorals. As it is, a

\* An ear-witness (Wittmans, in the "Neue freie Presse") gives the following report of Chinese theater music: "The star, dressed like a prima donna, sings an aria. This indeed is almost more than a European ear can stand. We simply cannot imagine how they can call such a maiming of the voice (*Stimmverquetschung*) singing. It is in this way that a raven croaks, a cat meows, a door creaks on its hinges, a dry boot-sole squeaks, a pig squeals, a wheel screeches under the brake; thus the Easter rattle of the street gamins resounds, but no human being ever sings in this way. The orchestra, besides, very seldom stops. The representation is almost continuously accompanied melodramatically. Higher dramatic movements are naturally treated more in detail, especially those of battle and conflict. The cymbals whirl, the tom-tom resounds, the whistles scream, the fiddles moan, and all is raging topsy-turvy, and over all the terrible kettle-drum rattles as if madness were wielding the hammer. Not a trace of harmonic combination. Here the genius of discord conspires with all evil music-hating fairies to call into existence a symphony of horrible noises of which we can simply form no conception." The Chinese are the oldest civilized nation, and take the same delight in their music as we in ours. Who is right? Both: we can here form no compromise. Our reporter adds: "In the living presence it (the theater) gives the impression of a senile art that has become childish." Will this also be the end of our theater, of our art?



Catholic would find it hard to accustom himself to the singing in common of all the congregation, just as a Protestant would not appreciate the mass, and the music of masses. Whoever seeks the opportunity of developing himself musically, must live into both these forms of Christian church-music, and will be able to find the melodious in both; it nevertheless requires a sort of historical self-adjustment. What now does the term "Melody" denote for us? One is accustomed to say: "A rhythmically formed succession of tones, which is agreeable to the ear." In general there is no objection to this, and we will now go into the matter a little more deeply.

I have previously pointed out that music developed into a "science of tones" chiefly because it connected itself with such word-thoughts (Wortgedanken) as were rhythmically formed in verses; by this it was bound to a certain form of rhythmic repetition. If one sang the music without words, or played it on an instrument, then one had a rhythmically ordered succession of tones, a "melody," which *probably still bore the traces of speech cadence, but could exist by itself*. Thus arose the regular, absolute music, music without words. I heard in Grosswardein, if I am not mistaken, several czardas, which pleased me very much, played by a somewhat civilized gypsy orchestra; when I found out that they were composed by the first violinist, I asked him if he had had them printed; he answered: "Not yet. I must first look for words for them." Witty persons among the populace not infrequently make new verses for existing well-known dance tunes of a definite rhythm; the improvised quatrains call forth the same enjoyment among the people that improvised couplets do among the audience of a theater. Thus at one time the music comes first, at another the words; that in the beginning, however, the words formed the point of crystallization for the music is my opinion. That the successions of tones, which were rhythmically joined on account of the words and verses, might separate themselves from the words, and gradually become forms which sounded independently of the words and were differently connected, is just as comprehensible as the fact that, later on, new speech-rhythms developed without reference to tones. The forms of the science of tones, when separated from the words, gradually attained a certain degree of independence, and found the *new condition of their development in the new material*. Thus independent instrumental music arose. Its derivation from church music, march music, dance music and work songs, can be plainly recognized in the forms of our modern instrumental music. The suites of Bach are composed of the melodies of dance music: courante, sarabande, pascaglia, gavotte, minuet, gigue. The minuet has maintained its position in sonatas and symphonies down to the present day. Marches, and especially funeral marches, still occur in serious concert music. The rhythms of riding songs, traveling songs, thrashing songs, anvil songs (Schmiede Lieder), sailor songs (when heaving the anchor), spinning songs, harvesting songs, etc., have been derived from the rhythmic movements of the body and are arranged for them. If, indeed, they have not been used for

purely instrumental music in exact song form, they have enriched it by means of their various rhythms. Since language is one of the prime factors which affects musical rhythm, it follows that international intercourse, which brought us more frequently into communication with the languages and popular music of other nations, has enriched international music with very many new rhythms; it (music) has taken up the rhythm of the national English, Scandinavian, Italian, Slavic, Hungarian dance-songs and dances.

It will probably be universally admitted that we can conceive of a "melody" only as a rhythmically ordered succession of tones, and that this rhythm arises from different sources. But the above definition of "melody" requires also a succession of tones *pleasant* to the ear. One at once asks: "Pleasant to what ear?" If one answers somewhat like this: "To a musical ear," the question at once arises: "What are the characteristic signs of a musical ear?" We thus get into a circle of questions, from which I find no exit. We do not inquire about rhythm, whether it is unpleasant or pleasant; the most one can say is that a quick rhythmic motion can be disagreeable for us, if we are in a contemplative, quiet mood; it disturbs us or tires us on account of accompanying it, and the like; but a rhythm as such, independent of our moods, does not easily arouse an impression of the beautiful or the ugly. It is different with successions of tones. The series C', F' sharp, B', F'', and also C, C sharp, F' sharp, B, give me an unpleasant impression; why? because so pronounced an after-sound (Nachklang) remains in my ear when these tones do not follow one another too quickly, that I experience all four sounds as a combination of sounds, and this combination displeases me. Here, again, we may come back to harmony. In the popular, conventional term of modern music, a tone series seems pleasant, if it moves within the harmonies to which we are accustomed and which therefore have become agreeable to us. Thus we conclude that melody and harmony are most intimately connected. If one recalls any melody that has become popular, one finds it moves within easily scanned, not too variable harmonies and successions of harmonies, which have become customary to us (conventional), and that it finally returns to the key from which it started. This, indeed, constitutes what we usually call the melodious. The number of persons who are sufficiently musical that they can not only sing simple songs together but can also be taught songs in parts, is uncommonly large in the German nation. German-Austrians are especially distinguished in this respect. At St. Gilgen near Salzburg, on the banks of the beautiful Aber lake, where I usually make my summer abode, they have a small chorus and a small wind orchestra; the people take the greatest delight in singing and playing together, and practice new pieces every winter. And yet the village has but twelve hundred inhabitants. Naturally one must not criticise these performances too severely; but the pleasure to be derived from music is sufficient to pay for some little trouble to obtain it. The music of the mass, in which such of the children and grown persons as are suited for it are trained by the

organist and schoolmaster, gives more scope for church music than the singing in unison of the chorals in the Protestant order of worship. The Catholic service also has a powerful effect on the imagination, inasmuch as it draws to its aid music, painting and colored sculptures (for the statues of the Madonna, Christ and the saints are always painted). Hence also are derived influences which permeate the everyday life of the people.

The connection of the rhythmic and the harmonic is probably generally recognized; indeed, to some extent, it is always assumed. Similarly the desire and the striving to multiply the succession of harmonies is intimately connected with the same wish in regard to melody, and this holds good just as far for rhythm as for the succession of tones. The music which we have discussed previously is usually termed popular, because it readily spreads through large masses of society. But this does not satisfy those who feel the need of much music, and who from an innate disposition always think of music, and from inner compulsion must always busy themselves with it. Even in church music, not only as regarded the choir, but also the individual singers, there arose the desire for change, for something new. Men became wearied not only by the successions of harmonies, which finally became tiresome from eternal repetition, but also by the melodies, which always proceeded at the same rate and changed but little in rhythm, and which were originally sung by the tenor, then possibly also by the bass, and finally almost exclusively by all in harmony. Attempts were made to have the voices not always commence and finish at the same time, but to enter gradually, and to let some cease occasionally. Again, the rhythms were divided into smaller parts or enlarged, without bringing about any interruption in the harmony. The latter change led to the so-called polyphony. Each single voice went its own way without disturbing the harmony of the whole; in order to preserve the unity of whole, they came together from time to time, and necessarily, of course, at the end. Thus arose the canon, fugue and other tone forms; music had gained the mastery over words. The new method became popular and underwent further and further extension. The rhythmic element (rhythmic motive), from which polyphony arose, for a while aroused more interest than the harmonic and melodious, indeed such exclusive attention was devoted to it that the harmonic was somewhat neglected, attention being mainly directed to the individual voices. So heedlessly did the composers proceed in this direction that music became more difficult to execute and more removed from the popular style, so that to a certain degree it represented even its antithesis. This led to a return to the predominantly harmonic and melodious. Naturally, in the excessive development of polyphony, the words and the total expression (*Gesamtausdruck*) of the word-thoughts suffered; the excessive and continuous polyphonic treatment of the voices no longer corresponded to the state of mind which was meant to be called forth by the words. This conflict between music and the words, as well as between polyphony and harmonic melody has already lasted for sev-

eral centuries in the history of music. Hardly had certain concessions been made on each side when both the artist and the public wearied of them, and diverged again until new compromises were once more reached. Since the connection of word-thoughts and tone-expressions (*Tongestaltungen*) has no natural physical basis, but is purely conventional, this hesitation, how far we should favor the one or the other perception in their simultaneous action (the hearing of the words and thoughts or the hearing of the tones and tone series) will last as long as man speaks and sings at all. Language has developed its own forms for the expression of thoughts and impressions, for the purpose of poetical expression, according to certain conditions inherent in itself. Tone expressions have separated from the words and from song and have also developed into certain forms, into the science of tones, according to certain conditions which exist in the world of tones (*Tonwelt*). Nevertheless, the conditions under which the greatest effect of poetry and the greatest effect of music are developed are only partially the same; often they heighten each other, not infrequently they stand in complete contrast.

Turning our attention from the connection between tones and words, we may now glance at the development of instrumental music—the so-called absolute music. I can easily imagine that in times past the instrumentalists found it wearisome to always continue with the same rhythm in the conventional harmonies. Each one, therefore, began to make various changes for his own entertainment. So long as only one took this liberty, the innovation could serve to interrupt the monotony very pleasantly. If, however, every quartetist in every bar allowed himself such changes as suited him, in comparison with the conventional harmonic, the general effect would very often be bad. This tendency toward variation in the performance of quartets and symphonies probably lasted longest among the Italians. Thus Spohr in his autobiography\* speaks with horror of the variations which even the horn players and clarinetists allowed themselves in the accompaniment to one of his violin concerts at Rome. When not carried beyond moderation, however, variation also pleased the greater public, and the composers soon introduced more movement and a regular polyphony into their instrumental works. But the separation of music from words had still another result for the development of instrumental music. The melody was no longer bound to the order of words—it could, therefore, be used also piece-meal, and could be separated into single "motives" (*Bewegungsmomente*), which could then be utilized more freely; one could put the motives taken from the melodies alongside, over or under each other, and play with them at will harmonically and rhythmically. Indeed, melody in the former coherent form was no longer used; one could work nicely with shorter or longer motives, and then for a change bring in again a finished melody, and so forth. Thus new tone forms arose, based on a purely musical foundation, among which the so-

\* Vol. I, p. 330.



called sonata form soon gained the upper hand. From Scarlatti and Emanuel Bach down to Brahms it has been developed in many ways. Its essence consists in the change of rhythmic and harmonic motives, in partly predominantly polyphone, partly predominantly melodious development of tone forms. The rich diversity developed in this way in the hands of eminent composers has been striking; besides the sonata forms or even within them the harmonic variation of complete melodies—of a so-called theme—has been developed. One can, to be sure, call this playing with motives, and especially as regards the so-called development in the sonata form, a variation of the same, but this is not so strictly bound to a definitely formed theme. This development of purely musical forms, however, had a strange effect on that which we usually call melody. In polyphone music the attention is so much taken up in the pursuit of the rhythmic movement of the single voices, by the motives, which move away from each other, toward each other, over each other, that the discords which arise in passing are not heard, provided only that harmony sets in again at certain rhythmically important points. We can endure a considerable amount of dissonance, even long continued, provided only we feel in advance, by means of our impressions which are accustomed to the usual succession of harmonies, that consonance must soon set in. As a good instance the long trill on the seventh at the end of the *Athalie* overture by Mendelssohn may be taken. *The phenomenon that we principally and consciously perceive that upon which we concentrate our whole attention, leaving all else observed physiologically at the same time unnoticed,* is widely extended in the domain of sense-perceptions. Thus most persons have a number of opaque little points in the vitreous humor of the eye, which they do not notice so long as they look at objects and direct their glances at them, whereas they at once perceive them as so-called “mouches volantes,” as soon as they unconsciously look in the distance; similarly the after-images in the complementary colors do not disturb us because we do not notice them. The same, however, takes place in purely psychical phenomena. *It is an essential characteristic of the civilized man, which must be acquired from childhood, to direct, to concentrate the attention, the “inner aspect” upon some few concepts, whether they arise directly or are reproduced.*

We have previously admitted that the “melodious” consists essentially in the fact that the tone series takes place within accustomed harmonies which do not change too frequently. This conception, however, becomes much more enlarged for the musically educated; he gets accustomed not only to pass over transient discords, but even to feel them to be agreeable or at least “interesting,” provided that at the same time he can clearly perceive the most important lines along which the tone masses proceed. If we hear only firm, strong bass notes, and retain them to a certain extent as a melody or theme, it does not matter if we hear at the same time rising or falling diatonic or chromatic scales. Indeed, even series of harmonies existing strong and firm can be made more interesting for us by parallel scales; we do not notice

the momentary passing of horrible discords. Take, for example, the introduction to Mozart’s “Don Juan” overture. If we designate these scales as a melody, probably no objection can be made, although there is a tradition that Mozart inserted them in the score later on. Chromatic tone series occur so often in melodies and motives, from Bach on to Brahms and Wagner, that we have grown completely accustomed to them; we transfer the rhythmic movement of the tone series (that which one calls in painting the lines or outlines) to the inner point of hearing (physical and psychical) and do not notice that which resounds at the same time.

It would not be very difficult for a good composer to make an interesting musical motive out of the tone series which, as I said before, sound disagreeable to me—the tone series Bach (b, a, c, h) and Aeb (a, e flat, c b) out of which Liszt and Schumann made fugues, do not sound much prettier when heard for the first time—yet after becoming used to them by frequent repetition, one may consider them melodies.<sup>10</sup>

As long as the appearance of transient discords does not pass beyond a certain limit, it entertains and interests us; for that which we conventionally are accustomed to experience as harmonious wearies us, if its effects are continuous and unchanged. But where is this limit of the interesting? How long can we endure the discords and complication of rhythm without having our enjoyment lessened? This cannot be determined, inasmuch as here we have to deal with purely individual, and up to a certain degree, social factors of sensation (*Empfindungsmomenten*, esthetic motives). Much always depends upon how many follow, as disciples of

<sup>10</sup> On the piano, inasmuch as it is difficult to distinguish the various voices of a polyphonic piece on account of the weak sounding (*Fortklingen*) of tones that are held, and also on account of the same tone timbre of the instrument, harmonic harshnesses are especially emphasized. To play fugues for the piano is very interesting; to simply listen to them affords very problematic enjoyment; the same holds true of other polyphonic music written for the piano, especially of complicated musical compositions arranged for four hands. Well rehearsed polyphonic orchestral and choral music is much easier to understand, because the single voices stand forth better on account of the difference of the tone colors of the various instruments and voices. The fact that difficult music (*schwierig zu bewältigende*), especially a string quartet, sounds perfectly horrible when played by otherwise practiced dilettanti, is principally due to the uncertainty and timidity with which the tones are sounded and the bow is moved. Therefrom arise so many uncertainties, and so much scratching and scraping is heard alongside of the tones, that much good will and endurance are required to listen to new and complicated music under such conditions. On the piano one plays either correctly or incorrectly; in string music (and also in wind music), there are so many shades of incorrectness which we designate as impurities, that the hearer often does not know what he is hearing, and how it really ought to be. I must also confess that I have seldom heard string quartets, even those composed of the best artists, which at the beginning of a concert sounded absolutely clear to me. Does it depend on the performers or on the fact that the ear in a large room must first accustom itself to the combination of sound from the four string instruments, which is most beautiful in itself?



a so-called new style of composition, that new composer who predominantly pursues the interesting. If he has really found the direction toward which the soul of the musical, or indeed of the unmusical people was striving, then he will gradually find more and more disciples; if he has not found this direction, they will let him go by himself and laugh at him.

Helmholtz expresses that which we have developed in this section in our own fashion, in the following manner, in his classical book:<sup>11</sup> "The amount of harshness which a hearer is inclined to endure as a means of musical expression, depends on his taste and his habits; therefore the boundary between harmony and discord has often undergone changes. In the same manner tone-scales, tone-modes and their modulations have been subject to manifold changes, not only among uncultured and rude peoples but even in those periods of universal history and among those nations, in which the most perfect flowers (Blüthen) of human culture were developed (zum Aufbruch kamen)."

From this follows the conclusion, which is not yet sufficiently impressed upon the minds of our musical theorists and historians, that *the system of tone-scales, of tone-modes, and of the harmonious interweaving of the same does not rest upon immutable laws of nature, but is the result of esthetic principles, which in the progressive development of humanity are subject to change, and will continue to be so in the future.*

#### CONCLUSIONS.

In expressing my personal impressions on Billroth's contribution to the psycho-physiology of music, I may say that it is an admirable attempt and largely a successful one, to blend and harmonize the esthetic aspects of music on the one hand, with the physiologic and physical aspect on the other. That this is a task of exceptional difficulty is proved by the fact that few successful writers on this subject have emanated from the German nation. Helmholtz in his "Sensations of Tone" has emphasized this difficulty. He holds<sup>12</sup> that it is a mistake to make the theory of consonants the essential foundation of the theory of music and insists that the essential basis of music is melody. This is at the outset a confession which affords great comfort to the esthetic worshippers of music. The life and essence of music, therefore, do not depend upon physical, mathematical or physiological facts, but upon melody—a psychological entity. Helmholtz in his well-known work, incurred the enmity of two classes of critics, those of an esthetic or psychological bent, and those of a physical or mathematical leaning. The same experience would have fallen to the lot of Billroth had he lived to see the publication of his book; the fact that the volume was not printed until after his death modified the fierceness of the critics. Nevertheless, a few of them have brought forward the same objections that Helmholtz' work aroused. The Latin proverb *Mortuo leoni et lepores insultant*,

(Even hares can insult a dead lion), applies to these critics, but perhaps the best answer to them is found in the work of Helmholtz just quoted: "Harmony has become to Western Europeans during the last three centuries an essential, and, to our present taste, indispensable means of strengthening melodic relations, but finely developed music existed for thousands of years and still exists in ultra-European nations, without any harmony at all. And to my metaphysico-esthetical opponents I must reply, that I cannot think I have undervalued the artistic emotions of the human mind in the Theory of Melodic Construction, by endeavoring to establish the physiological facts on which esthetic feeling is based. But to those who think I have not gone far enough in my physical explanations, I answer, that in the first place a natural philosopher is never bound to construct systems about everything he knows and does not know; and secondly, that I should consider a theory, which claimed to have shown that all the laws of modern Thorough Bass were natural necessities, to stand condemned as having proved too much."

It is true that acoustics constantly employs conceptions and names borrowed from the theory of harmony, and speaks of the "scale," "intervals," "consonances," and so forth; similarly, manuals of Thorough Bass generally begin with a physical chapter which speaks of "the numbers of vibrations," and fixes their "ratios" for the different intervals. But, up to the present time, this apparent connection of acoustics and music has been wholly external, and may be regarded rather as an expression given to the feeling that such a connection must exist, than to its actual formulation. Physical knowledge may indeed have been useful for musical-instrument makers, but for the development and foundation of the theory of harmony it has hitherto been totally barren. And yet the essential facts, within the field here to be explained and turned to account, have been known from the earliest times. There is good evidence for believing that Pythagoras (B. C. 540-510) knew that when strings of different length, but of the same make and subjected to the same tension, were used to give the perfect consonances of the Octave, Fifth, or Fourth, their lengths must be in the ratios of 1 to 2, 2 to 3, or 3 to 4 respectively, and if, as is probable, his knowledge was partly derived from the Egyptian priests, it is impossible to conjecture in what remote antiquity this law was first known.

Concerning the limits of the purely psychical ("rein Psychische") in the perception and interpretation of Music Helmholtz (l. c.) admits that: "Musical esthetics has made unmistakable advances in those points which depend for their solution rather on psychological feeling than on the action of the senses, by introducing the conception of movement in the examination of musical works of art. E. Hanslick, in his book 'On the Beautiful in Music' triumphantly attacked the false standpoint of exaggerated sentimentality, from which it was fashionable to theorize on music, and referred the critic to the simple elements of melodic movement. The esthetic relations for the structure of musical compositions, and the characteristic differences of individual forms of composition,

<sup>11</sup> First edition, p. 358.

<sup>12</sup> Translation by Alex. J. Ellis, Preface, page vii.

are explained more fully in Vischer's 'Esthetics' (Aesthetik). In the inorganic world the kind of motion we see reveals the kind of moving force in action, and as the only final method of recognizing and measuring the elementary powers of nature consists in determining the motions they generate, so it is also for the motions of bodies or of voices which take place under the influence of human feelings. Hence the properties of musical movements which possess a graceful, dallying, heavy, forced, dull, powerful, quiet, or excited character, and so on, chiefly depend on psychological action. In the same way questions relating to the equilibrium of the separate parts of a musical composition, to their development from one another and their connection as one clearly intelligent whole, bear a close analogy to similar questions in architecture. But all such investigations, however fertile they may have been, cannot have been otherwise than imperfect and uncertain, so long as they were without their proper origin and foundation, that is, so long as there was no scientific foundation for their elementary rules relating to the construction of scales, chords, keys and modes, in short, to all that is usually contained in works on 'Thorough Bass.' In this elementary region we have to deal not merely with unfettered artistic inventions, but with the natural power of immediate sensation. Music stands in a much closer connection with pure sensation than any of the other arts. The latter deal rather with what the senses apprehend, that is with the images of outward objects, psychical processes collected from immediate sensation. Poetry aims most distinctly of all at merely exciting the formation of images, by addressing itself especially to imagination and memory, and it is only by subordinate auxiliaries of a more musical kind, such as rhythm, and imitations of sounds, that it appeals to the immediate sensation of hearing. Hence its effects depend mainly on psychical action. The plastic arts, although they make use of the sensation of sight, address the eye almost in the same way as poetry addresses the ear. Their main purpose is to excite in us the image of an external object of determinate form and color. The spectator is essentially intended to interest himself in this image, and enjoy its beauty; not to dwell upon the means by which it was created. It must at least be allowed that the pleasure of a connoisseur or virtuoso in the constructive art shown in a statue or a picture, is not an essential element of artistic enjoyment.

No doubt the ultra physical psychologist would have been more pleased if Billroth had succeeded in localizing a circumscribed area of the cerebral cortex and given experimental and pathological evidence that it was the center for musical apperception, as Broca did for the centre of speech.

But when we are guided into the understanding of the true nature of musical apperception the difficulties in the way

towards such an anatomical basis for a cortical musical centre become evident.

The sensation and consciousness of music after all that has been said is something more than "*a psychic process collected from immediate sensation.*" The relation of musical apperception to the sense of hearing is something more intimately psychical than the relation of the senses to the functions of their anatomical end organs (*e. g.*, of the sense of sight to the eye or rather to the retina).

To utilize the comparison of Helmholtz in the introduction to his *Sensations of Tone*.

"It is only in painting that we find color as an element which is directly appreciated by sensation, without any intervening act of the intellect. On the contrary, in music, the sensations of tone are the material of the art. So far as these sensations are excited in music, we do not create out of them any images of external objects or actions. Again, when in hearing a concerto we recognize one tone as produced by a violin and another by a clarinet, our artistic enjoyment does not depend upon our conception of a violin or clarinet, but solely on our hearing of the tones they produce, whereas the artistic enjoyment resulting from looking at a marble statue does not depend on the white light which it reflects into the eye, but upon the mental image of the beautiful human form which it calls up. In this sense it is clear that music has a more immediate connection with pure sensation than any other of the fine arts, and, consequently, that the theory of the sensations of hearing is destined to play a much more important part in musical esthetics, than, for example, the theory of perspective in painting. Those theories are certainly useful to the artist, as means for attaining the most perfect representation of nature, but they have no part in the artistic effect of his work. In music, on the other hand, no such perfect representation of nature is aimed at; tones and the sensation of tone exist for themselves alone, and produce their effects independently of anything behind them."

Although no such contribution to localization as that of Broca has been made by Billroth in his psycho-physiological aphorisms on music, nevertheless his work will prove of value because of the general clearing of the entire subject of physical and physiological acoustics and by rendering the work of Helmholtz more accessible and more intelligible to musical artists and connoisseurs so that they may hereafter become conversant with the scientific aspect of their art. Above all, by pointing out the gaps and breaks in the experimental and practical logic he has emphasized the gaps that must be filled before we may hope to reach more tangible results concerning the purely psychological aspects of music.

### THE JOHNS HOPKINS HOSPITAL BULLETIN.

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## REPORT ON THE EXAMINATION OF THE EARS OF 440 SCHOOL CHILDREN.

By H. O. REIK, M. D.,

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In November, 1899, I was asked by the principal of a large school in Maryland to take part in an anthropologic investigation which he had instituted among his pupils. My portion of the work was to consist in an examination of the ears, primarily for the purpose of determining the number having defective hearing, and, secondarily, to make measurements of and note defects about the auricle. The general body measurements were made by the director of physical culture, the eyes were examined by an ophthalmologist, the teeth by a dentist, and I incidentally examined the nose and throat because of the frequency with which ear troubles originate in these organs. All of the work was done with considerable care, and I anticipate a complete report from the school which will be of interest to all who are concerned in the management of schools or the general advancement of improved educational methods.

In the report which I am about to present I shall confine my remarks almost entirely to the otologic investigation which proved of great interest to me, of considerable value to some of the pupils, and which, I trust, will be applied to other schools in the future. We all realize the great benefits resulting to the children from the eye examinations conducted in our public schools during the past few years, but up to the present time we have not given the ear its proper consideration. It is almost, if not quite, as important an organ as the eye and the fact that it is not so frequently diseased and that a slight defect, which may be the beginning of serious trouble, is not so readily detected at an early stage by the child or its guardians renders it all the more imperative that it should receive the same watchful care we have inaugurated for the protection of the eye.

The method which I employed in making this examination was quite simple and yet fairly complete. A large room in a quiet portion of the school building was placed at my disposal and a schedule prepared assigning the pupils to definite appointments with me at stated times. With the aid of a small alcohol stove a pan of water was kept constantly boiling and aural and nasal specula, tongue-depressors, etc., were sterilized in every instance before using. The accompanying blanks were used in recording the findings of examination. They were prepared in accordance with my own suggestion and served their purpose fully. Blank A is somewhat more elaborate, in regard to the hearing tests, than would be required in an ordinary examination of school children. Blank B is merely a letter to the parents or guardians of the child, and blank C it will be noticed was prepared solely for scientific purposes and contains nothing that would be of practical value in ordinary school work. After recording the name, age, sex, and the history of any previous trouble with

the ears, the external auditory canal and tympanic membranes were examined for evidences of any present or past trouble. Anterior rhinoscopy only was employed in examining the nares, and in looking at the pharynx no instrument was introduced into the mouth except a tongue-depressor. It was thought best to make this part of the examination as simple as possible and submit to its being incomplete, and in a few instances somewhat unsatisfactory, rather than risk any objections from the children or their parents. The tests of hearing were made with as much accuracy as possible without special and elaborate preparation.

I am not at liberty at present to name the school at which this investigation has been conducted, but I may say it is located in one of the largest counties of the State, in a healthy prosperous community which might serve as a good index of the general conditions in this State and the children were in every way a fair average of the children attending Maryland public schools, or, I think I might even say American public schools.

The total number of children examined was 440 and their ages ranged from 3 to 21 years, most of them—378—being between 7 and 17 years old (see table No. 1).

The hearing tests used, as shown by blank A, detected a deficiency of hearing in 45 or almost exactly 10% of the entire number examined. In 13 of these, however, the defect was due simply to accumulation of cerumen in the external auditory canal and could be easily remedied. In the remaining 32 instances the faulty hearing was the result either of former disease of the ear or of present abnormal conditions of the ear, nose or throat which would require the attention of physicians accustomed to deal especially with those organs. Thus, there were 2 cases of chronic otorrhœa; 6 of troublesome adenoid growth in the naso-pharynx; 7 of catarrhal otitis media; 1 obstructed Eustachian tube; 8 showed scar tissue in the tympanic membrane, the result of former inflammatory trouble; 14 had hypertrophied tonsils, and in some of these there was probably also some adenoid growth. Of the purely nasal affections noted there were 13 children with hypertrophied inferior turbinates; 5 deflected septa and 2 nasal spurs. In addition to these, 1 case of bifid uvula and 1 very markedly cleft palate were noted. Of course, a defect of hearing did not invariably accompany an abnormality of the throat or nose, but changes in these organs were recorded whenever they were of sufficient degree to require attention. In the majority of the 45 cases referred to, the loss of hearing was only slight and the prospects of partial or complete restoration under proper treatment would be good.

Here I desire to consider briefly one point which forced itself upon my attention during these examinations, namely:



the normal limit of hearing for high tones. Dench in his work on Diseases of the Ear states that "The normal ear perceives vibrations as musical notes repeated at regular intervals from 16 v. s. to about 32,500 v. s.," and these points "may be called the lower and upper limits of audition respectively." This statement is perhaps generally accepted in so far as the lower tone limit is concerned, but the upper tone limit has not yet been definitely settled. According to Zahn,<sup>1</sup> Sauveur believed that 6400 vibrations constituted the highest perceptible note; Chladin made the number 8192 and Walloston 25,000. Savart showed that it was possible to hear a sound corresponding to 24,000 vibrations; Despretz was able to obtain sounds whose frequencies were over 36,000 vibrations, and Appunn makes a set of tuning forks, the highest of which is calculated to give 49,152 vibrations per second."

Some years ago Dr. Blake<sup>2</sup> made some very careful observations on this subject, using König rods for the tests and concluded that the perceptive power of hearing high musical tones varies with the age. At about 12 or 13 years of age a tone of 40,960 v. s. was heard 34 feet, while at from 28 to 30 years only tones of 32,768 v. s. were perceptible, and as the age further advanced the limit of perception still further diminished. Preyer and others have obtained similar results.

The instrument most commonly used for determining the upper tone limit is the Galton whistle, and for practical purposes it answers very well, though it is perhaps not so scientifically accurate as the high-pitched tuning forks or the König rods. Working with such a whistle, Bezold made a series of examinations and came to the conclusion that the normal high point of hearing would be registered on the whistle at 1.50. Alderton and others have placed it at 1.25 for children and from that on down to 3. or more for adults.

For some time I have been inclined to consider these points too low for a normal standard. Very frequently have I examined adults who could clearly distinguish a much higher note and I was not, therefore, very greatly surprised to find these young people doing the same. At first I thought the explanation might lie in a hyperacuity of hearing, just as we frequently find children with 20/15 or even 20/10 vision. When at the close of the work, though, I found that the vast majority of those examined had shown a much higher record than the supposed normal, I began to feel a conviction that the standard had been placed too low.

There are a number of difficulties in the way of making accurate tests with the whistle. It is hard to get a large number of individuals to distinguish, with any degree of nicety, between the sharp whistling sound and the accompanying blowing or puffing sound. As this might be especially so of very young children I shall not consider those under 10 years of age, nor shall I include those above that age who evidently did not appreciate the test. Aside from those two classes I have the records of 220 people between

10 and 20 years of age in whom I believe the test was made with a fair degree of accuracy. I may state that the whistle which I used was one made especially for the purpose under the supervision of Dr. B. Alexander Randall of Philadelphia. One perceived the whistle at 1.2; 6 at 1.; 2 at .9; 4 at .8; 11 at .7; 13 at .6; 97 at .5 and the remaining 53 claimed to distinguish it at .3 or .4 of a turn. This would give an average upper tone limit as shown by .6 of a turn on the whistle. The whistle was held from 10 to 12 inches from the ear.

It would be very unwise to draw any conclusions from this examination, inasmuch as the tests were not made with such a purpose in view and hence were not properly guarded and proven, but the evidence is presented because of its suggestive nature and in the hope that it may lead to a discussion which will throw more light on this point than I have been able to obtain from the literature of the subject. If it be anywhere near correct, then the normal limit for high tones is far above 32,000 v. s. or even 49,000 in young persons and many of these can hear over 70,000 and some over 100,000 vibrations per second.

Although not of much practical value one of the most interesting features of the examination was found in the study of the auricles and their peculiarities. Anatomical irregularities and deformities of the auricle have formed the basis of a great many papers and a great deal of consideration has been given to the question of the relation of these markings to the stigmata of degeneration, but as yet very little seems to have been done to determine what constitutes a normal ear. As a natural consequence the recorded aural examinations show no semblance of agreement upon a classification of abnormalities. The most complete classification I have seen is that given by Krauss in his article on "The Stigmata of Degeneration" in the *American Journal of Insanity*, July, 1898, but, as Hrdlicka remarks, in the report of his anthropological investigations, "It should be kept in mind, first of all, that many of the abnormalities of which we shall speak are simply the results of states of malnutrition, or certain pathological conditions, and do not indicate inferiority any more than would a pale skin after a hemorrhage or so many scars after wounds." Hrdlicka conducted a most thorough anthropologic study on 1000 white and colored children in the New York Juvenile Asylum and 100 children in the New York Colored Orphan Asylum, and his report is of extreme interest and great value. In preparing the list of irregularities observed in my examination I have merely elaborated somewhat the same arrangement he used and we may make use of some of the figures for comparison.

Hrdlicka states that "It is a fact, although we have no real statistics on this point, that any of the abnormalities met with in this institution can also be met with occasionally in the children of any class or social position." My slight experience would incline me not only to endorse but to emphasize this statement, for, as may be seen by a comparison of our statistics, I found some of the same abnormalities present in normal, healthy public school children in almost exactly

<sup>1</sup> Sound and Music, p. 83.

<sup>2</sup> Trs. Amer. Ot. Soc., 1872.

the same proportion that be found them among the white children of the Juvenile Asylum.

Before proceeding further I should state that I have accepted and employed as a standard the following description of what constitutes a normal ear: It should be about twice as long as broad and in its attachment to the head should bear an angle of not less than 15 nor more than 30 degrees. It should have a gracefully curved outline, being nowhere pointed or irregular, have a well-defined helix, separated from the antihelix by a distinct scaphoid fossa extending down nearly to the level of the antitragus. The root of the helix should be lost in the concha before reaching the antihelix. The antihelix should not be unduly prominent and should have a well-marked bifurcation at its superior extremity. The lobules should be shapely, not adherent nor too pendulous and free from grooves extending from the scaphoid fossa.

It will be noticed, as might be expected, that the number of abnormalities was much greater among the boys than among the girls, and the difference is especially marked in the varieties of malposition and defects of the helix. This is due no doubt to the rougher life the boys lead and to their manner of applying hats, caps, etc.

The position of the auricle is considered as important as its form development, and the very large percentage of criminals showing such malposition is noteworthy. Thus, in a measurement of over 1000 criminals at Elmira, 72% showed an auriculo-temporal angle of 15 degrees or over and the same condition was found with 57% of the boy criminals at Pontiac, while a large part of the remainder had very close-set auricles (15% or less) which is likewise an abnormality. In my measurements only 0.5% showed an angle of less than 15°, and only 12.5% angles of 15° or more, leaving 87% with ears well placed.

Measurements of the auricle were carefully taken after the system devised, I believe by Bertillon, for the identification of individuals, and, if we separate the boys and girls and then divide each into groups covering periods of 5 years, we find the average measurements to be those given in Table No. 2. It would seem that the auricle gradually increases both in length and width with each year of life up to the twentieth, and I believe others have claimed that this growth continues throughout life. Certainly the most rapid growth is in the earlier years and the annual increase is slight after the fifteenth year. The largest ear measured was possessed by a boy and was 73 mm. long by 40 mm. wide, while the largest girl's ear was not far behind, being 70 mm. long by 40 mm. wide; only one other girl came within 5 mm. of this measurement, but there were five other boys beside that limit.

In 142 of the pupils there were differences, more or less slight, between the right and left ears. In some instances one ear would be larger than the other in every measurement, in some longer than the other but of the same width, or even narrower, and vice versa. In no case did the difference amount to more than 5 mm. The right ear was longer than the left in 62 instances and wider than the left in 15.

while the left was longer than the right in 48 and wider than the right in 25. So in most instances when there was a difference, the right was the larger ear.

It will not be necessary to consider the abnormalities of form in detail. Reference to the accompanying table (No. 3) will give their nature and frequency. A few specially marked instances may be worth consideration, however, not only because they represent more or less typical forms of degenerate ears that were seen in children who possessed none of the other stigmata of degeneration. The accompanying photographs were prepared for the stereoscope and lose something of their effect as reproduced.

Fig. 1. A boy, 18 years of age, of good physical development and an unusually bright student; according to his teachers, "One of the best in the school." The auricles are short and broad, 56 by 37 mm., but the auriculo-temporal angle is good. The left auricle shows somewhat better development than the right. The helix is curled in its horizontal portion, but very slightly in the upper part of the vertical portion and bends back on itself, giving the antihelix undue prominence. The concha is large and deep. The antitragus points directly outward, and the lobule is bent back towards the tip of the mastoid process.

Fig. 2. A 15-year old girl, of normal development, both mentally and physically. Left ear slightly larger than the right. The vertical portion of the helix is undeveloped and at its junction with the horizontal portion is a well-marked Darwin tubercle. In this case also the antihelix is made prominent by the bending backward of all the more external portion of the auricle—the helix and scaphoid fossa. The incisor teeth are slightly notched and there is one supernumerary on the left side.

Fig. 3. Boy, 14 years of age; physical examination shows the right shoulder a little high but no curvature of the spine. In school work he is very apt and is considered in many respects quite a genius. The ears are of normal size and position. The vertical portion of the helix is deficient, constituting merely a rim and the scaphoid fossa slopes backward and outward. On the right helix there are two distinct tubercles. The lobules are short and adherent, the inferior margin directly continuous with the cheek. The antihelix is notched just above the antitragus.

Fig. 4. A female, 13 years old, described by her teachers as an "average child, perhaps a little slow mentally." Taken in its entirety the ear is of normal size but some parts of it are overdeveloped, as the antitragus is very large and the lobule is both long and broad.

Fig. 5. A female, 8 years of age, with a good school record. The auriculo-temporal angle is a little less than 15 degrees. The vertical portion of the helix is entirely deficient, and there is practically no lobule. The concha is large and deep.

Fig. 6. A female, 14 years of age, good physical and mental development. There is practically no horizontal portion to the helix, as from the upper anterior portion after a very slight rounding the helix runs obliquely downward and



FIG. 1.



FIG. 4.



FIG. 2.



FIG. 5.



FIG. 3.



FIG. 6.





Deficient.....	3	2
Very small.....	2	1
Very large.....	3	5
Adherent.....	1	1
Thickened and curled upwards.....	1	..
Bent back towards mastoid.....	1	..
Blind.....	..	1
Marked by continuation of fossa helcis.....	..	1

## EXPERIMENTAL INJECTION OF TESTICULAR FLUID TO PREVENT THE ATROPHY OF THE PROSTATE GLAND IN DOGS, AFTER REMOVAL OF THE TESTES.

BY GEORGE WALKER, M. D.,

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*(From the Anatomical Laboratory of The Johns Hopkins University.)*

In order to determine the relationship which exists between the prostate gland and the testes, I have instituted a series of experiments; the first of which I herewith give as a preliminary report.

It is now a well-known fact that the prostate gland undergoes an atrophy after the removal of the testes, and these changes have been most accurately studied by several investigators whose observations I have confirmed, in several instances, for my own satisfaction and instruction. These may be summarized thus: Twelve days after the removal of the testes, there can be seen a beginning change in the epithelial cells of the prostate gland; the protoplasm first begins to clear up; the nuclei lose their chromatin structure and diminish in size. Following this, the protoplasm becomes gradually less and less, and finally at the end of about six weeks it presents only a faint rim around a small, deeply-stained nucleus. The blood-vessels, which at first were large and turgid, very soon begin to shrink, and finally many of them are obliterated; the muscle undergoes fatty degeneration and is ultimately converted into, or replaced by, fibrous tissue. After a period of from eight months to one year, the gland is reduced to about one-fourth its normal size; the glandular structure is represented by only a few small tubules, lined by shrunken and quiescent cells, and the remainder of the gland is converted into fibrous tissue.

In order to ascertain whether the atrophy of the gland is induced by the absence of some substance in the testicular fluid; or in other words, whether there is any element in this fluid which stimulates the prostate and keeps it up to a normal condition, I instituted the following series of experiments: A certain number of well-grown, well-developed and apparently healthy dogs was selected. After a few days' confinement their testes were excised; one-half of these animals were injected with testicular fluid, every other day for five months and eighteen days. The remaining dogs were kept as controls. At the end of the above time, the animals were killed, and the glands taken out and examined.

The testicular fluid was thus prepared: the testes were removed from dogs very soon after they were killed; usually about twenty-five to thirty animals being available at once. The glands after removal were carefully freed from the tunica vaginalis, and the vas; the epididymis, however, was allowed to remain. The organs were then washed with water and ground to a fine pulp; this partially-fluid mass was accurately measured and an equal volume of 50% aqueous solution of glycerine was added. The mixture was then put on ice and allowed to remain for fifteen hours, at the end of which

time it was strained several times through a fine cloth. (Repeated attempts were made to pass it through a Pasteur filter, and also through ordinary filtering paper, but so unsuccessfully that the method was discarded.) Thus prepared the testicular extract was a reddish, thick, and slightly tenacious fluid, about the consistency of glycerine. To this was added as a preservative, a small amount of trikresol, dissolved in glycerine, so that the amount of the former represented one-fifth of one per cent of the whole volume; this was not sufficient to impart any odor to the solution. The extract was kept in a wide-mouth bottle, at the ordinary room temperature, for a number of weeks, during which time it remained perfectly pure and free from bacteria. During the course of the injections about 2000 cc. of the extract were used, which represented one hundred and twenty testes.

Ten cubic centimeters of this fluid, which represented five cubic centimeters of the testicular extract were injected into the animals. The injections were begun on the third day after operations, and were made every day during the first ten days. Various parts of the back, loins and thighs were injected. The syringe used was a Parke, Davis antitoxine instrument which was cleaned before and after using by washing in a 1 to 20 solution of carbolic acid. The injections produced very little pain, and were accomplished without difficulty. No attempt was made to shave or to sterilize the skin.

After ten days the dogs became droopy, failed to eat, and were indisposed to play. The injections were stopped for several days, and they rapidly regained their former health. After this, the injections were resumed and continued every alternate day; no further trouble ensued. The uninjected animals were kept in the same place and were fed on the same food, and had in every way the same environment.

At the end of five months and eighteen days the dogs were killed by chloroform; their glands removed, examined macroscopically, and fixed in a solution containing 3% chromic acid and 5% acetic acid, preparatory to making microscopic sections.

The result may be summed up in a few words: The prostate gland in the injected animals presented both macroscopically and microscopically the same changes that had occurred in the uninjected ones. It may be said, therefore, that the injections of the testicular fluid had apparently no effect whatever, and one is probably justified in concluding that the atrophy of the gland is in no way connected with the absence of any substance in the testicular secretion.



# A PLEA FOR EARLY NAKED-EYE DIAGNOSIS AND REMOVAL OF THE ENTIRE ORGAN WITH THE NEIGHBORING AREA OF POSSIBLE LYMPHATIC INFECTION IN CANCER OF THE LARYNX.<sup>1</sup>

BY JOHN N. MACKENZIE, M. D.,

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Leaving out of consideration the probable existence of a cancer bacillus and the possible future detection of the disease through the blood and secretions, there remain, in the present state of our knowledge, three principal methods of diagnosis in laryngeal cancer. These are, in the order of their practical usefulness and importance: (1) The naked-eye method, or diagnosis by direct inspection supplemented by clinical phenomena. (2) Thyrotomy, and finally, (3) The microscope. Of the three methods, the second is often included in, and therefore ancillary to the first.

It is impossible to exaggerate the importance of naked-eye diagnosis in the detection of laryngeal cancer. Take it all in all, it is by far the most practical of the three methods. Unfortunately, in most quarters it is relegated to a subsidiary place. Even the best of laryngeal surgeons lose no time in procuring portions of a suspected growth for microscopic examination before they have gone thoroughly into the history of the case and carefully endeavored to make the diagnosis with the naked eye alone.

Every resource and refinement of clinical diagnosis should be resorted to before an appeal to the microscope is made.

As the advanced workers in the field of general surgery have, in the differentiation of tumors, come less and less to seek the counsel of the pathologist, except as a court of the very last resort, so should we teach ourselves to depend more and more upon the naked-eye appearance in the diagnosis of tumors in the windpipe. The removal of the "piece for microscopic examination" too often means only the beginning of the end.

The trained surgeon of to-day discriminates with marvelous accuracy (with the naked eye) between the different varieties of benign and malignant growths and we should cultivate and encourage a like amount of skill in the diagnosis of laryngeal tumors.

But, suppose, after weighing carefully all the facts of the case in our possession, a reasonable doubt remains as to the diagnosis, shall the next step be the removal of a portion of the diseased structure for examination?

In the face of all authority to the contrary, I say, emphatically, "No." Before even considering such a proposition (if it be considered at all), the suspected growth should be examined from every point of view, for in this manner alone can we give the naked-eye method its full measure of

usefulness. This is best accomplished by the second method—thyrotomy, or, if necessary, even more extensive external division of the tissues of the neck.

Thyrotomy is justifiable, in such cases, when laryngoscopic examination either leaves reasonable doubt as to its true nature, or manifestly fails to define the exact territory occupied by the disease.

Much can be learned by this method, but it too has its limits of usefulness. For, while it alone may establish with certainty the existence of cancer, it often fails to define with absolute accuracy the whole area covered by the morbid process. We can, therefore, never be perfectly sure, especially in cases in which the cancer appears as a diffuse infiltration, that we have the entire disease before our eyes. For, as I have formerly pointed out, as it is often impossible to indicate with exactness the extent of the trouble laryngoscopically, so after division of the larynx, and even after the removal of the latter organ from the body, it is by no means always possible to map out the entire distribution of the affection.

But suppose, after division of the larynx, there still remains uncertainty as to diagnosis, are we justified under the circumstances and at this stage, in removing a portion of the growth for examination? Or, to make the question still broader, is partial extirpation of the tumor ever admissible even for the purpose of microscopic diagnosis? Only as a measure of the very last resort. Before resorting to thyrotomy in general, especially if a portion of the growth is to be removed for examination, it should be clearly understood beforehand with the patient, that, if the disease should prove to be cancerous, the surgeon shall be at liberty, if in his judgment it seems best, to proceed at once to operation.

The objections which I would urge against removal of tissue for examination (especially when done through the natural passages) are (1) it subjects the patient at once to the dangers of auto-infection at the point of incision and to metastasis elsewhere; (2) it stimulates the local growth of the cancer and (3), finally, the method is often inconclusive, misleading and sometimes practically impossible.

The moment the continuity of the growth is broken, in that very moment is opened the pathway for self-poisoning, and an unfavorable influence is at once exerted on the local process. This is the solemn lesson which I have slowly learned from a sad experience in the past.

Cancer is an infectious process. Whether it be due to a bacillus, which is possible, or whether its activity be due to some vital principle inherent in the cancer cell, incision

<sup>1</sup> Abstract of remarks made in opening the debate on Cancer of the Larynx at the Twenty-second Annual Congress of the American Laryngological Association, May 2, 1900.

through the cancerous mass opens up at once a broad avenue for auto-inoculation. Serum therapy will some day play the most conspicuous rôle in the treatment of this disease.

For, surgical treatment, to be sufficiently radical, involves the sacrifice of so much tissue that the time must surely come when surgery will be supplanted by simpler and more certain means and with the discovery of the agent of infection will come its antidote. But to-day the knife is our only means of cure. How can we best employ it?

The general principle of treatment in cancer of the larynx is sufficiently simple. It is, or should be, identical with that which governs us in the treatment of cancer elsewhere in the organism. Total extirpation, *through liberal portions of healthy tissue*, of the growth, together with the neighboring area of possible lymphatic infection, is the cardinal principle of surgery in the treatment of this disease, for by no other method can it be thoroughly eradicated.

The surgical treatment of laryngeal cancer has resulted in failure in the past because the methods employed have not been sufficiently radical. Thyrotomy with curettage or partial removal, partial and complete removal of the larynx have fallen far short of success simply because they have not completely removed the disease. The records of the future will show that the reason so many cases have terminated in failure and death is because the disease has only been partially removed. As long as we have lymphatics to carry infection and glands to become infected, so long will the patient be subjected to ultimate danger. There is only one rational method, in the majority of cases at least, of dealing with cancer of the larynx. Early total extirpation of the entire organ with its tributary lymphatics and glands, *whether the latter be apparently diseased or not*, is the only possible safeguard against local recurrence or metastasis. By no other method can we give the patient a reasonable assurance of a permanent lease of life.

The surgeon who is abreast with the times does not trifle with cancer in other organs. Why should the larynx be made the exception to the rule? I am told that there are some gynecologists who still curette the uterus for cancer and some surgeons who still remove half the breast in that disease, but like the Democrats who still vote for Andrew Jackson for President they are becoming every day more and more hopelessly in the minority. We shall have to learn the same lesson here that we are slowly learning in the case of cancer in other parts of the body. It is the same old fight and the same old obstacles will have to be overcome.

It is often impossible by inspection either with the laryngoscope or after preliminary division of the thyroid, by transmission of light or by the sense of touch, to limit the extent of the disease before operation. As I have demonstrated, even after removal of the larynx, the disease may be apparent in one side of the organ and not in the other and yet the microscope show extensive carcinomatous deposit in the seemingly normal side. Especially is this the case in diffuse infiltration or when the epithelioma originates in the deep-seated tissues and does not approach the surface until

a late stage of the disease. The loose tissue beneath the mucous membrane in many places and its wealth in lymphatics often favor from a small focus of infection infiltration of other portions of the larynx and sometimes with great rapidity.

Diffuse infiltration, even though confined to a small area, should always awaken suspicion of the existence of the disease elsewhere in the organ, even though no apparent signs of its presence exist.

It is also possible that in its early history, we may find young cancer cells in the lymphatics, as Halsted has demonstrated in the case of cancer of the breast.

In the presence, therefore, of the fact that it is often impossible to limit the diseased area by inspection and the sense of touch, and in the light of the revelations of the microscope, it becomes a serious question whether we accomplish any lasting good by any operation short of complete excision of the larynx and the neighboring lymphatics and glands. Certainly, if the disease approaches the middle line, the imperative necessity of complete removal must be apparent to the most timid and doubting operator.

While total extirpation of the organ with the neighboring area of possible lymphatic infection should be the general rule of practice, are there exceptional cases in which a less radical method of procedure is justifiable?

Early cases in which the growth is very small (as, for example, the small papillomatous and polypoid growths, sometimes found on the cords), distinctly circumscribed, remote from the middle line and not of a specially malignant type may possibly be removed with safety by extirpation of half the larynx and the lymphatics of the corresponding side. Even here success may be due to the fact that while the growth may be pathologically malignant, it may yet be clinically benign. For example, on other mucous membranes of the body (lips, mouth, bladder, etc.), and on the skin, we find such neoplasms in which the microscope shows an epitheliomatous structure in the main body or superficial portions of the growth, but no malignant changes in base or pedicle. It is quite probable that such a condition exists in the larynx. But even in removal of half the larynx and neck lymphatics we can never be perfectly sure that we have removed the entire disease, whilst it is open to doubt whether the preservation of function which may be secured thereby is sufficient to warrant the risk. Partial preservation of function should never be attempted in the presence of the slightest danger to life.

Operations for laryngeal cancer through the mouth, done almost universally to-day, it seems to me, should no longer come within the range of serious consideration.

Thyrotomy with curettement or removal of all apparent (visible) disease is not up-to-date surgery, is in direct defiance of the rules that should govern us in the treatment of cancer, and is a reversion to, and a resurrection of a method of procedure that was discredited and abandoned over half a century ago.

Whatever operation be done, it should be forever borne in



mind that we are dealing with cancer—with an infectious process—that no matter how minute the original point of infection may be, the area of possible poisoning is practically boundless, and that, if the slightest doubt exists as to the circumscription of the growth, the complete operation should be done.

No operation for laryngeal cancer is complete without the removal of the neck lymphatics.

It is chiefly because they have not been complete, that excision of half the larynx or of the whole organ has so signally failed in the past.

The history of the treatment of laryngeal cancer is the same old wretched story of the treatment of cancer in other organs—the long and melancholy record of dismal failure after failure—the inevitable result of only partially removing the disease. What is the present status of the subject? As far as operative measures are concerned, there seems to be utter paralysis of effort—on every side we are confronted by practical failure. Without stopping to inquire how far apparent success in partial removal of laryngeal cancer may be due to mistakes in diagnosis or to the simple accident of

good fortune, it is safe to say that in the present state of our knowledge the outlook is extremely unsatisfactory and sombre. In the presence of the great uncertainty that surrounds operations for partial removal and in the light of our experience in the modern treatment of cancer in other organs of the body, shall we resort to complete extirpation of the larynx with the neighboring area of possible infection, or shall we cling with fatuous persistency to what some one has called, with cruel felicity of expression, the “incomplete operation,” under which term must be included all surgical procedures hitherto resorted to in this disease?

The time will surely come, if it has not already come, when the conscientious surgeon will consider that he has fallen far short of his duty both to his patient and to himself if he does not, in the treatment of cancer of the larynx, remove not only the entire organ, but also the neighboring lymphatic area. Then and not until then, will we have more favorable statistics and prognosis in cancer of the larynx. Then and not until then, will the medical historian chronicle a real advance in the management of this terrible disorder.

HEREDITY IN DIABETES MELLITUS, WITH A REPORT OF SIX CASES OCCURRING IN A FAMILY.<sup>1</sup>

BY J. HALL PLEASANTS, M. D.

I wish to report six cases of diabetes mellitus occurring among the members of a single family in three generations. The cases are of special interest since they illustrate very well certain features of the hereditary form of diabetes. Five of the six cases have been under personal observation.

Heredity has been long recognized as a factor in the etiology of diabetes, but its importance has been generally underestimated. The first reference to diabetes as a family disease which I am able to find in the literature occurs in Richard Morton's *Opera Medica*, Amsterdam, 1696. In his chapter on diabetes he cites the case of a father and son who suffered from the disease. Among other early writers who called attention to the fact that heredity may sometimes enter, were Blumenbach and Isenflamm. In Rollo's *Cases of Diabetes Mellitus*, 1598, Storer of Nottingham directed attention to what he termed “mild habitual or family diabetes,” and cited two families in which several members were diabetic. In one of these cases the father is said to have died of diabetes, while a son, a daughter and a grand-daughter suffered from a mild type of the disease. Thomas in the same work reports a similar case. During the present century numerous writers have contributed to our knowledge of the part played by heredity.

Statistics showing the proportion of cases of diabetes in

which heredity enters vary considerably, as the following figures, which I have collected, illustrate:

Flint <sup>2</sup> .....	27.56
Bouchard <sup>3</sup> .....	25
Fitz and Joslin <sup>4</sup> .....	23.8
von Noorden <sup>5</sup> .....	21.8
Schmitz <sup>6</sup> .....	21.1
Seegen <sup>7</sup> .....	14
Naunyn <sup>8</sup> .....	11.7
Zimmer <sup>9</sup> .....	10.6
Williamson <sup>10</sup> .....	10.5
Frerichs <sup>11</sup> .....	9.75
Grube <sup>12</sup> .....	7.9
Johns Hopkins Hospital Series (112 cases) <sup>13</sup>	5.3
Wegeli <sup>14</sup> (in children) .....	29

The marked variation in these figures is probably largely due to the class of patients upon which the different statistics are based. Those based upon hospital and dispensary cases are lower, owing to the difficulty in obtaining satisfactory medical histories from such patients. Thus Naunyn<sup>8</sup> reports from his private practice 17-20 per cent of cases giving a history of heredity, while of the patients from his clinic only 4.4 per cent gave such a history. For the same reason the figures based upon an analysis made by Dr. T. B. Fletcher and myself of 112 cases treated at the Johns Hopkins Hospital and Dispensary up to June 1, 1900,

<sup>1</sup> Read before the Johns Hopkins Hospital Medical Society, June 4, 1900.



are low. Fitz and Joslin omit cases in which the family history has not been especially inquired into, so that their figures are of especial value. It seems probable that heredity enters in from 20 to 25 per cent of all cases of diabetes.

A study of 60 cases of diabetes in which an hereditary history was obtained, founded upon an analysis of six cases treated at the Johns Hopkins Hospital and upon the series of cases reported by Flint,<sup>15</sup> Fitz and Joslin<sup>16</sup> and Naunyn,<sup>17</sup> shows the occurrence of the disease among other members of the family as follows: father 15, mother 5, brother or sister 21, two sisters 1, brother and sister 4, uncle 7, aunt 3, grandfather 1, father and uncle 1. In two instances several members of the family were affected. One of these is the case reported by Flint in which six members of the family were diabetic. The other instance is that of the family reported in this paper. These figures show the frequency with which the disease occurs in a brother or sister, or in a collateral relation. In only 20 of the 60 cases was one of the parents diabetic. In only 8 of the series were more than two members of the family affected.

While it is comparatively rare to find more than two or three cases occurring among the members of a single family, there are several instances on record in which numerous individuals have been attacked in successive generations. The most remarkable of these is a case reported by von Noorden,<sup>18</sup> who publishes a pedigree of the family in question. In this case the disease affected ten members of a family in four generations, appearing in each successive generation at an earlier age. The family history was further complicated by intermarriages with other diabetic families. Isenflamm<sup>19</sup> reported seven diabetic children in a family. The editor of the *Indian Medical Gazette*<sup>20</sup> cites a case in which eight members of a Hindoo family in three generations are said to have suffered with diabetes. The following cases will be simply referred to: Flint<sup>21</sup> (the case already mentioned), father, paternal uncle, two sisters, and two brothers—only one case recorded and observed. Senator<sup>22</sup>—four children of a Polish Jew. Hertzka<sup>23</sup>—three brothers and a sister. Naunyn<sup>24</sup>—mother and four children. Bence Jones<sup>25</sup>—three brothers and a sister. Mosher<sup>26</sup>—father and mother, three daughters and a grandson. Frew<sup>27</sup>—child nine years old, uncle, aunt and grandfather. These are among the most striking cases which I have been able to collect from the literature and serve to show that diabetes may be at times distinctly a family disease. In many of these cases the writers have had but a single member of the family under observation, the occurrence of the disease among the other members being founded upon hearsay. In this connection attention may be called to the fact that several observers have found that in diabetic families there is often a history of epilepsy, insanity and the various psychoses. Obesity is often a characteristic of diabetic families, occurring in both diabetic and non-diabetic members. Syphilis has also been considered as playing an important rôle—one writer, Schüec,<sup>28</sup> going so far as to say that all cases of hereditary diabetes are due to lues in some ancestor.

The occurrence of diabetes in husband and wife is by no means uncommon, Schmitz<sup>29</sup> reporting 26 cases out of a total of 2320. Although 1.12 per cent seems a large figure, it is the general opinion that such cases of "conjugal diabetes" are accidental, and considering the comparative frequency of diabetes, cannot be regarded as affording evidence, that under these circumstances, the disease is ever contagious.

From a study of the reported cases of diabetes mellitus in which heredity enters and of my own cases, certain peculiar features of the family type of the disease are to be noted.

(1) The occurrence of the disease in an uncle, aunt or cousin, while the parents escape, is very often observed. This may be conveniently spoken of as the "collateral inheritance" of diabetes. In the same way a grandparent may be diabetic while the parent escapes.

(2) When successive generations are affected there is a tendency for the disease to develop at a progressively earlier age.

(3) When more than two members in the same generation are diabetic there is a tendency for the disease to appear at approximately the same period of life.

(4) While hereditary diabetes developing in the first two decades is often of a severe character, the cases developing later in life are generally of a mild type.

(5) In a certain number of cases the disease has appeared in the children prior to its occurrence in the parents.<sup>3</sup>

(6) There is frequently a neuropathic tendency in diabetic families. Cases are recorded in which several children were diabetic, while the others suffered from various psychoses.

(7) Obesity is often a characteristic of families in which diabetes occurs.

The cases which I wish to report to-night occur in two brothers and two sisters, an uncle and a great uncle, as is shown in the accompanying chart-pedigree. With the exception of the great uncle, Heinrich D—— who died in Germany about fifteen years ago all the cases have come under my personal observation. Apart from the diabetic taint the family history shows nothing of especial interest. All of the 23 descendants of the emigrant, Augusta M——, who are now living, are residents of Baltimore. With one exception, I have fortunately been able to make an analysis of the urine of all of these. In addition to these, one member of the family suffering from diabetes recently died at the Johns Hopkins Hospital, so that including Augusta M—— I am thus able to report upon the condition of 24 members of the family. In view of the interest at present attached to the so-called "conjugal diabetes," wherever possible the condition of those persons who have married into the family has been investigated. The result of these inquiries has so far been negative. The average of intelligence in the family is excellent. There is no history of epilepsy, insanity or other nervous trouble. One of the *diabetic* members of the family

<sup>3</sup> Two such cases are reported by Niessen,<sup>30</sup> Naunyn<sup>31</sup> and Grube<sup>32</sup> each report a case.

—John M.— has, however, had two attacks of delirium tremens. No luetic history is obtainable. Not a single member of the family is stout, but it is of interest to note that the father of the four diabetic brothers and sisters is a very large man, although the diabetic taint comes through the mother.

The following is a summary of the cases:

CASE I. Heinrich D—, the great uncle of Goslar, Germany, is said by his sister to have died of "Zuckerkrankheit" fifteen years ago at the age of forty. Three years before his death he was severely injured by a falling tree. Soon after the injury his general health began to fail. About one year previous to his death sugar was found in the urine. No further details of the case are obtainable.

CASE II. John M— the uncle—aged 28.

Complaints of nervousness.

*Past History.*—No acute diseases except measles and malaria, the latter two years ago. During the past seven years has suffered much from nervousness brought on, he thinks, by excessive drinking. Has had two attacks of delirium tremens within the past year. No history of lues.

*Present Illness.*—December 15, 1899, he was examined for admission into a beneficial society, and his urine found to contain sugar. Previous to this he did not know of the existence of diabetes. The examining physician reports to me that on two subsequent occasions sugar in large amounts was found to be present. The classical symptoms of diabetes are not very marked—the patient does not drink a very large amount of water, the urine is but slightly increased in amount, the appetite is moderate and there has been no marked loss in weight. He refuses to submit to a special diet.

*Physical Examination.*—The patient refuses to allow me to make a physical examination. In appearance he is tall and well developed. Color rather sallow. Seems very much upset about his condition. The examining physician informs me that nothing especial is to be made out in the chest or abdomen.

*Urine Analysis.*—This has been made by me twice. April 6, 1900: Sugar present, but the amount unfortunately not determined. Specific gravity 1036. No albumin or casts. April 24, 1900: Sugar .4%. Specific gravity 1020. Trace of albumin, no casts. No diabetic,  $\beta$ -oxybutyric acid or acetone present on either occasion. On the whole the case seems to be rather a mild one.

Cases III, IV, V and VI are brothers and sisters.

CASE III. Jacob S— nephew—aged 20. Tailor by occupation. Came under observation March 30, 1900.

Complaints of loss of voice and general weakness.

*Past History.*—No acute diseases except pneumonia when a child. No luetic history. Habits have always been good. Slight cough with expectoration for several years. One year ago his voice began to become weak and his cough more troublesome. The diagnosis of tuberculous laryngitis was made at the Johns Hopkins Hospital Dispensary, although diabetes was not suspected.

*Present Illness.*—There is no definite history of onset.

About one year ago the patient began to suffer from thirst and dryness of the throat. Drinks a rather large amount of water at times. Frequently voids two or three litres of urine a day. Appetite is large. During the past year there has been considerable loss in strength and weight. There is no pruritus. Now suffers from severe cough and night sweats.

The patient did not know of the existence of diabetes until four or five months ago when he was informed of the fact by his physician. Since then he has been at times on a restricted diet.

*Physical Examination.*—In appearance the patient is a frail and badly-nourished boy. Very anemic; no zanthomata or other cutaneous lesions; no dryness of the skin; no fruity odor of the breath. The throat examination shows tuberculous ulceration of the larynx. Examination of the lungs shows an advanced tuberculous process in the upper left lobe while there are signs of beginning involvement of the right apex. The physical examination is otherwise negative.

*Urine Analysis.*—March 29, 1900. Urine shows 2.9% of sugar. No diabetic acid;  $\beta$ -oxybutyric acid or acetone; urine otherwise negative.

CASE IV. Charles S— nephew—aged 16; clerk. Came under observation March 30, 1900.

Complaints of dryness of throat.

*Past History.*—No acute diseases except measles and chicken-pox; no luetic history; no history of malaria. Habits have always been good.

*Present Illness.*—The patient says that his general health is good. For the past year he has been troubled with dryness of the throat. Five months ago he had two fingers cut off by machinery. Following this for several days he was very nervous and had a low fever which his physician called "malaria." Since then the dryness of the throat has increased. For the past year he has taken a good deal of water to drink; his appetite has increased and the amount of urine has increased. All these symptoms have become more marked since the accident. He thinks that there has been a slight loss in weight.

The patient was not aware of the existence of diabetes.

*Physical Examination.*—The patient is a well-developed and well-nourished boy, slightly anemic in appearance. There is no fruity odor of the breath. No zanthomata or other skin lesions; no dryness of the skin. The examination of the throat, thorax and abdomen is negative. Both knee-jerks are absent.

*Urine Analysis.*—This has been made twice. The patient has not been on a restricted diet. March 29, 1900. Sugar 3.7%; specific gravity 1037; no diabetic acid or  $\beta$ -oxybutyric acid. There is a distinct trace of acetone. Urine otherwise negative. March 31, 1900 (24 hours' specimen); amount in 24 hours, 2050 cc.; sugar 5.3%; specific gravity 1041. No diabetic acid,  $\beta$ -oxybutyric acid or acetone.

CASE V. Augusta S— niece—aged 16; schoolgirl.

Came under observation April 1, 1900.

There is no complaint about her health.

*Past History.*—The patient has always been strong and



healthy. Chills and fever every other day when about six years of age. Measles and chicken-pox as a child. The patient is subject to attacks of tonsillitis. She first menstruated five months ago.

*Present Illness.*—The patient says that she feels strong and well. Her appetite is quite large; drinks a good deal of tea and coffee; does not suffer much from thirst; no dryness of throat; voids between two and three litres of urine a day. The patient does not know how long she has been voiding this much, and has never thought the amount excessive. It is impossible to assign the time of onset of the disease. There is no dryness of the skin, zanthomata or skin eruption. The patient was not aware of the presence of diabetes.

*Physical Examination.*—The patient is a well-developed and very well-nourished girl. The complexion is brilliant. Lips and mucous membrane are of a good color. There is no fruity odor of breath. There are no zanthomata. An examination of thorax and abdomen is not permitted. Seems in excellent general physical condition.

*Urine Analysis.*—Two analyses have been made. The patient has not been on a special diet. April 1, 1900: Sugar 1.5%; considerable albumin; no diabetic acid,  $\beta$ -oxybutyric acid or acetone. April 30, 1900: Amount in 24 hours 2600 cc.; sugar 1%; specific gravity 1016. No diabetic acid,  $\beta$ -oxybutyric acid or acetone; trace of albumin.

CASE VI. Drucilla S—niece—aged 10. Schoolgirl. Admitted to the Johns Hopkins Hospital March 22, 1900. Died April 6, 1900.

Admitted complaining of rheumatism.

*Past History.*—Measles when six years of age. There have been three previous attacks of rheumatism; no history of malaria.

*Present Illness.*—For three weeks preceding her admission the patient had been suffering with acute articular rheumatism. She also complained of pain about the heart. Had never noticed that she drank much water or that she voided much urine. Appetite is not large. At times she had pruritus of the scalp. There has been no decrease in strength or weight.

*Physical Examination.*—The patient is a fairly well-nourished girl. Not anemic in appearance. There are no zanthomata or other cutaneous lesions; no dryness of the skin; odor of breath not fruity. There is considerable tenderness over the involved joints. The heart-dulness is increased, and there is a loud systolic murmur at the apex. A marked friction rub is heard over the body of the heart. Nothing further made out on examination.

After admission to the hospital her condition gradually became worse. She died April 6, 1900, with all the symptoms of cardiac disease. During the greater part of her illness there was considerable fever, often reaching 104°. None of the symptoms of diabetic coma were present at any time. The blood examination did not show the existence of lipæmia. There was a slight reaction with Bremer's test.

The patient was at no time on a diet entirely free from carbohydrates.

*Urine Analysis.*—During the fifteen days that the patient was under observation in the hospital a very careful daily determination of the sugar, diabetic acid,  $\beta$ -oxybutyric acid, acetone, ammonia and urea was made by Dr. Erlanger. The amount of urine in 24 hours varied from 740 to 2260 cc. The sugar ranged from 1.5 to 4.6%. The specific gravity ranged from 1016 to 1039. At times, diabetic acid, acetone and  $\beta$ -oxybutyric acid were all detected in the urine, the latter on one occasion reaching .35%. The urine towards the last contained a trace of albumin, but no casts.

*Autopsy.*—Fortunately a post-mortem examination was obtained. The heart showed the presence of a marked endocarditis and a serofibrinous pericarditis. The examination of the abdominal organs showed nothing of importance. The pancreas was possibly slightly enlarged, but microscopical examination revealed nothing abnormal. The liver was practically normal. The brain and cord could not be examined.

An analysis of these six cases brings out certain points of interest which illustrate well some characteristic features of hereditary diabetes. An inspection of the chart-pedigree shows that the disease was probably inherited through the great grandfather Bernhard D—, as he has diabetic descendants through both of his wives, although considering the advanced age at which he died—88—it is improbable that he himself suffered from the disease. The grandmother—Augusta D—is living and well. Her urine is absolutely negative. The same is true of Theresa S—, the mother of the four diabetic children. These cases thus bring out very well what I have called the "collateral inheritance" of diabetes, there being probably no history of diabetes in an ancestor in three generations at least. The age at which the disease has first made its appearance is a more difficult matter to determine. In the case of the great uncle it was discovered at 40, in the uncle at 28, and in the four nephews and nieces at ages ranging from 10 to 19. We have here the disease appearing in succeeding generations at a progressively early age. In the third generation the disease has appeared approximately at the same period of life; i. e., all the cases are in the second decade. In regard to the severity of the disease in the family under consideration, it is as yet, too early to speak definitely. The cases at present under observation do not seem to be of a severe type, in some of the cases the existence of any trouble being unsuggested. In the one fatal case which I have been able to observe, death was not due to diabetes. As stated previously there is no definite neurotic family history or history of obesity.

The negative evidence which has been brought forward by a study of the urine of 24 out of 25 members of the family, is of interest, and should additional members of the family at a later time develop the disease, will be of importance in determining the time of its onset. If possible the family will be kept under observation and any later developments which may be of interest will be reported.

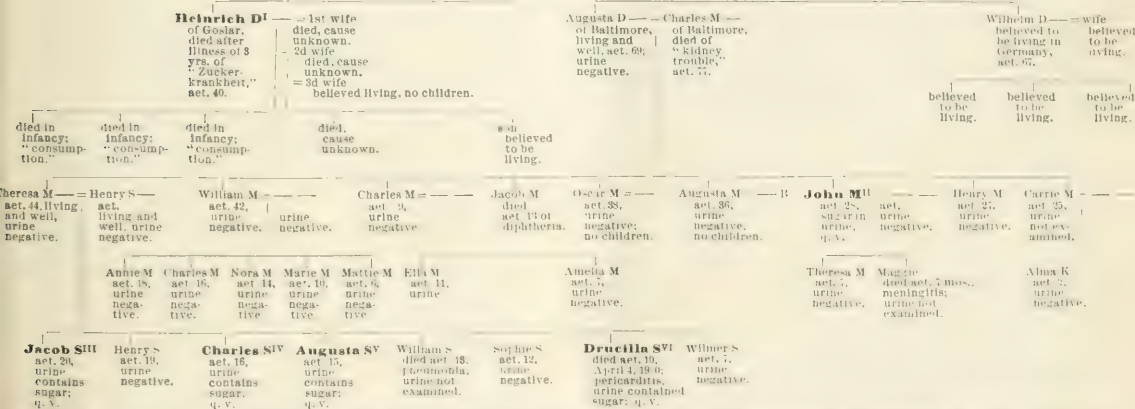
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1st wife	Bernhardt D— = 2d wife
died, cause	of Goslar in
unknown	Harz Mts.,
	Germany
	Died of "old
	age," act. ss.



Injuries of the ureter requiring anastomosis are almost ex-

clusively surgical, that is to say, they are produced in the course of operations when they can often be detected at once and immediately repaired. The injury is almost invariably confined to the pelvic portion of the ureter, and if any part is sacrificed the loss is limited to the pelvic end. The injury is, for the most part, involuntary on the part of the operator, as when he cuts a ureter for a blood-vessel or unwittingly picks it up along with the ovarian vessel at the pelvic brim and ligates and divides it there. In other instances it is torn out of the pelvis with an adherent ovarian cyst, myoma, pyosalpinx, extra-uterine pregnancy or tuberculous mass. A voluntary sacrifice is made when the ureter passes through a carcinomatous mass in the broad ligament in caliber." An instrument which Kelly uses to overcome these difficulties, known as a ureteral guide, is then described and the manner of using it is explained. Then follows an abstract of six cases in which anastomosis of the ureter was performed.

ROBERT L. RANDOLPH, M. D. A Review of Recent German Ophthalmic Literature for the Quarter Ending June 30, 1900.—*Annals of Ophthalmology*, July, 1900.

— An Insurance Case in Which Ossification of the Choroid Led to the Identification of the Body.—*Ophthalmic Record*, July, 1900.

The case was that of a man whose body had lain at the bottom of the Niagara river for nine months. When discovered, the body was so badly decomposed that the insurance companies refused to pay the insurance, claiming that it was impossible to identify the remains. The family, however, remembered that one eye (left) had been blind for years from an injury. The eyes were examined and an ossified choroid in the left eye was the only remaining recognizable structure which was found. This was sufficient to show that the eye had been blind for years and the companies accepted the evidence as conclusive and paid the insurance.

THOMAS R. BROWN, M. D. Poisoning with Snake-Venom.—*Twentieth Century Practice of Medicine*, Vol. XX, pp. 491-538.

In this article the subject of poisoning with snake-venom is considered in full.

The subdivisions of the article treat of the poison-apparatus of the snake and the mode of injecting its venom; varieties of poisonous snakes and their distribution; the properties of snake-venom; chemistry of venom; toxicity of various venoms and causes of variations in toxicity; effect of heat, cold and various reagents upon venom; effects of various digestive ferments upon venom; relation of venom to various other products of albumin hydration; mode of entrance of the venom into the body; mode of elimination of venom; symptomatology; morbid anatomy; physiological and pathological effects of snake-venom, as shown by experiments upon animals; diagnosis; causes of death in snake poisoning; prognosis; prophylaxis; treatment, local and general or constitutional; treatment with antivenomous serum and the production of artificial immunity; immunity of snakes and certain animals; specificity or non-specificity of antivenomous serum; relation between snake-venom and antivenene; treatment of other diseases with snake-venom and antivenene; medico-legal value of antivenene.

Especial attention is paid to the treatment of snake-bite by antivenomous serum or antivenene, while the rôle that this serum has played in establishing our views regarding the relation between toxin and antitoxin is carefully considered.

At the conclusion of the article there is a carefully compiled bibliography of all the important works published on this subject since 1886, Weir Mitchell having furnished a complete bibliography up to that time.

JOSEPH C. BLOODGOOD, M. D. Traumatic Rupture of the Popliteal Artery with Gangrene of the Leg—Amputation—Recovery.—*The Maryland Medical Journal*, September, 1900.

The case was one of dislocation backwards of the right knee-joint, with a subcutaneous complete transverse rupture of the popliteal artery at its bifurcation. The popliteal artery was plugged with a thrombus. There was no hematoma in the popliteal space. Thrombosis of the popliteal vein was diagnosed. Gangrene of the leg began immediately after the injury. The condition of the patient, when admitted three hours after the injury, was one of extreme shock, not associated with great loss of blood. The patient was observed for three days; there was a high temperature (104.8° F.) and a leucocytosis of 8000, due probably to fibrin ferment, as the extravasated blood and gangrenous tissue were sterile. There was amputation through the condyles of femur on the third day, and the patient recovered.

WALTER JONES, M. D. Ueber die Darstellung des Thymins.—*Zeitschrift für physiologische Chemie*, Bd. 29. Heft. 6.

J. H. MASON KNOX, JR., M. D. Compression of the Ureters by Myomata Uteri.—*The American Journal of Obstetrics*, September, 1900.

HENRY J. BERKLEY, M. D. Clinical Cases, VI.—Death from an Unusual Cause in a Case of Dementia Paralytica.—*American Journal of Insanity*, July, 1900.

OTTO G. RAMSAY, M. D. The Surgical Treatment of Primary Renal Tuberculosis, with a Consideration of the Immediate and Remote Results after Operation.—*Annals of Surgery*, October, 1900; *Annals of Gynecology and Pediatrics*, June, 1900.

HUGH H. YOUNG, M. D. Suprapubic Retrocystic Extraperitoneal Resection of the Seminal Vesicles, Vasa Deferentia, and Half of the Bladder.—*Annals of Surgery*, October, 1900.

J. WHITRIDGE WILLIAMS, M. D. Teaching Obstetrics.—*Philadelphia Medical Journal*, September 1, 1900.

JOHN J. ABEL, M. D. On the Teaching of Pharmacology, Materia Medica, and Therapeutics in Our Medical Schools.—*Philadelphia Medical Journal*, September 1, 1900.

LEWELLYS F. BARKER, M. D. The Anatomic-Cytological Relationship of the Neurone to Disease of the Nervous System.—*Journal of Nervous and Mental Diseases*, September, 1900.

HUNTER ROBB, M. D. Notes on the Enemata Employed after Abdominal Sections.—*Cleveland Medical Gazette*, September, 1900.

W. W. FORD, M. D. Sarcoma and Cirrhosis of the Liver.—*American Journal of the Medical Sciences*, October, 1900.

WILLIAM E. HUGER, M. D. Report of a Case of Encysted Periurethral Gravel.—*Maryland Medical Journal*, October, 1900.

STEWART PATON, M. D. A Study of the Neurofibrils in the

Ganglion Cells of the Cerebral Cortex.—*Journal of Experimental Medicine*, Vol. V, No. 1.

WILLIAM OSLER, M.D. General Summary of the Cases of Typhoid Fever Treated in the Johns Hopkins Hospital for Ten Years.—*Philadelphia Medical Journal*, October 13, 1900.

— The Visceral Lesions of the Erythema Group.—*British Journal of Dermatology*, July, 1900.

JESSE W. LAZEAR, M.D. Pathology of Malarial Fevers, Structure of the Parasites and Changes in Tissue.—*Journal of the American Medical Association*, October 13, 1900.

## PROCEEDINGS OF SOCIETIES.

### THE LAENNEC.—A SOCIETY FOR THE STUDY OF TUBERCULOSIS.

Tuesday, October 30, 1900.

This Society has been organized to systematize and stimulate the work on tuberculosis in the hospital, to educate its members, and to diffuse in the profession and the public a knowledge of the disease. Monthly meetings will be held throughout the session. The programme will consist of a historical review of the great epochs relating to the disease, a critical summary of the conditions relating to tuberculosis in the United States, with a presentation from each of the departments of the hospital of the work on tuberculosis during the first decade, and minor items relating to the symptomatology of the disease. Dr. Osler was elected Chairman of the Society.

I. *Introductory remarks* by the Chairman dealt with the importance of the study of tuberculosis in the profession, and he emphasized the fact that the chief work in the battle with the disease must be done by the general practitioner.

II. *Tuberculosis in the writings of the Fathers to Galen.*—Dr. Osler summarized and read extracts from the writings of Hippocrates, Aretæus, Celsus and Galen. The fairly full knowledge possessed by Hippocrates is indicated by the following statements: He knew that it was the most common of all diseases. He recognized it also as a febrile disease. He mentions its hereditary character. He describes what has been called the phthisical habit of body. He knew the significance of hæmoptysis and its relation to consumption. Many of the clinical features were known accurately—the fever, the cough, the sweats, the diarrhoea, the falling of the hair, the change in the finger tips. He did not know it as a special malady or a specific disease, but it was believed to arise either from an inflammation of the lung which terminated in abscess, or when the pituita or phlegm dropped in large quantities from the head to the lungs and changed into pus, when the blood in a hæmorrhage from the lungs was converted into pus, and, lastly, as a consequence of pleurisy. The contagious nature of the disease is apparently not mentioned by Hippocrates, though it is stated to have been known to his contemporaries, and is referred to by Galen.

The remarkable description by Aretæus of the general features of consumption was then read.

III. *Report on the social and domestic conditions of 190 cases of pulmonary tuberculosis in attendance at the Medical Dispensary of the Johns Hopkins Hospital*, by Miss Adelaide Dutcher.—Two years ago some friends presented the hospital with a sum of money which was to be used in promoting the work on tuberculosis, and it was felt that an important practical help could be given if in every case of tuberculosis applying to the hospital for relief some one would visit the patient's house and give personal instructions as to the mode of life and the care of the sputa. This has been carried out faithfully, first by Miss Epler, and during the present year by Miss Dutcher, who presented a report of the year's work. She divided the cases into three groups—of the whites (exclusive of the Russians), the Russian Jews and the colored. So far as the sanitary surroundings were concerned, the following were the figures:

	Rus.	Bl.	W.
Bad sanitary location . . . . .	69%	40%	30%
Insufficient light and ventilation . . . . .	83	71	46
Overcrowding . . . . .	76	50	46
Personal and household uncleanness . . . . .	75	66	43

A full report of the paper will appear in the BULLETIN.

IV. *Suggestions for a Library on Tuberculosis*, by Dr. Welch.—It is proposed, in connection with the tuberculosis fund, to establish a library in which all of the important works on the subject will be gathered. The subject was discussed under the following heads:

1. Historical—the monographs of Waldenburg and Predohl.
2. Epochal works of the first rank.
3. Epochal works of the second rank.
4. General or comprehensive works—ancient and modern.
5. Works and monographs on special aspects of the disease.
6. Tuberculosis of special organs.
7. Transactions of Congresses.
8. Journals devoted to tuberculosis.
9. Records relating to the crusade against tuberculosis.

This paper also will appear in a subsequent number of the BULLETIN, and it will be very helpful to students interested in the disease.



## NOTES ON NEW BOOKS.

Bacteriology and Surgical Technique for Nurses. By EMILY M. A. STONEY, Superintendent of the Training School for Nurses, St. Anthony's Hospital, Rock Island, Ill. (Philadelphia: W. B. Saunders & Co., 1900.)

This little volume contains a short and comprehensive account of what is meant by bacteriology. It is hardly to be thought that nurses will know much more than the actual terms used in the description of bacteriological technique; this volume seems to furnish fully as much information as they can appropriate in regard to bacteriology. It is well at least that they should know the relation of bacteriology to disease.

The latter part of the book contains a good account of antiseptics, disinfectants and surgical technique. It is, of course, a compilation, but the knowledge seems to have been judiciously gathered. The information is clearly and concisely given.

Transactions of the Medical Association of Georgia. Fifty-first Annual Session, 1900. (Atlanta, Ga.: The Franklin Printing and Publishing Company, 1900.)

This volume, of upwards of 400 pages, contains the usual number of papers read at the meeting of any State Medical Society. Some of them, it is probable, were mainly interesting to the writers, as, for example, "False Gods and Fake Priests of Medicine," or "The Physician the Nation's Guardian." The majority of the papers, however, are upon practical subjects, and many are valuable. One paper, on the "Woodbridge Treatment of Typhoid Fever," is largely polemic in character. It is interesting to notice that the author speaks of using the Woodbridge tablets of various numbers (1, 2, 3) in the multiform complications of the disease. The conception of typhoid fever as an entity which can be combated by routine remedies prepared to order is, to say the least, a singular one at this age of the world. The Medical Association of Georgia is to be praised for the excellent character of most of the work done at the annual session.

The book is well printed. It would have been much improved by a careful, analytical index.

A Book of Detachable Diet Lists.<sup>1</sup> By JEROME B. THOMAS, JR., A. B., M. D., Instructor in Materia Medica, Long Island College Hospital. (Philadelphia: W. B. Saunders, 1900.)

Some time since we had occasion to notice the first edition of this book. The second edition has been improved in many ways. The lists presented are sufficiently varied to meet the wants of the sick-room, and the system of detachable slips is a great convenience to the busy practitioner. It is a useful and convenient little book.

Tuberculosis; Its Nature, Prevention, and Treatment, with Special Reference to the Open-air Treatment of Phthisis. By ALFRED HILLIER, B.A., M.D., C.M., Fellow of the Royal Medico-Chirurgical Society, London. (London, Paris, New York and Melbourne: Cassell & Company, Limited, 1900.)

This admirable little book should be in the hands of every physician. Although written for conditions existing in England, it is equally valuable for conditions in this country. It gives a detailed and readable account of tuberculosis; its means of transmission from man to man and from animals to man. It also treats clearly of the methods of prevention. It shows that tuberculosis is not inherited, but transmitted; that the disease is not infectious or contagious, in the ordinary sense of the term, but communicable. The plea made for the careful examination of herds of cattle to prevent the sale of contaminated milk,

should be listened to in every city, as also the general statement that all milk from suspicious sources should be boiled. In fact, in the light of recent outbreaks of typhoid fever, it is not too much to say that all milk procured in the open market should be boiled before it is used. In no other manner can it be made safe for the consumer.

The chapters on treatment are excellent. Of course the open-air treatment is recommended. The author makes a necessary distinction between living in the open air and needless, reckless exposure to inclement weather. We are glad to see also a protest against the notion that tuberculosis is prevented by hardening children. The rationale of the open-air treatment is very well stated in the following extract: "Pure air cannot destroy the microbe buried in the tissues, but it can so intensify and invigorate the cellular elements of those tissues as to enable them to do so, and this it does not merely by its oxygen or by its comparative freedom from carbonic acid, but by virtue of its freedom from the organic impurities which the respiration air contains, those impurities thrown off among other effete or waste products of combustion within the body through the channel of the expired breath. Provide the cells of the tissues with pure air, a normal requirement, and the fungus, the tubercle bacillus, is either checked or destroyed in its growth upon them. But, on the other hand, as manure an effete animal product, put into land causes the vegetable seed sown in it to flourish; so do these respiratory organic impurities (another form of manure), or effete animal product, reinhaled into the lungs and reabsorbed by the tissues, cause the vegetable fungus, tubercle bacillus, to flourish. Some one has described breathed air, which is saturated with respiratory impurity, as containing air sewage. The term exactly describes the condition, and this sewage constantly bathing the soil or tissues of the consumptive causes the vegetable tubercle bacillus to grow and thrive in them. Cut off the supply, or, in other words, subject the patient to open-air treatment, and the bacillus is starved and checked in its growth."

In the latter part of the book excellent views of sanatoria for consumptives are given. There seems no reason why in every State of the Union similar inexpensive buildings should not be erected for the treatment of consumption. As the author well says, the treatment of consumption is not a matter of latitude or climate, but rather of altitude and dryness of the air.

A Manual of Personal Hygiene. Edited by WALTER L. PYLE, M. D., of Philadelphia. (Philadelphia: W. B. Saunders & Co., 1900.)

The editor does not tell us in his preface for what constituency his book is a candidate. There are many things in the work that are too simple to be meant for the profession, and others that are too professional for the laity. Yet both will find much good common-sense advice as to many matters of personal hygiene. The object of the work is to give "the best means of developing and maintaining physical and mental vigor." There are seven sections contributed by different authors. Dr. Stockton, of Buffalo, writes on the hygiene of the digestive apparatus. In addition to matters of food and drink, the care of the teeth is fully described. Dr. Fox, of New York, writes on the skin and Dr. Ingals, of Chicago, on the respiratory organs. Probably the most valuable chapter is by the author himself on the hygiene of the eye. Sections on the ear by Dr. Randall, on the brain and nervous system by Dr. Courtney, and on exercise by Dr. Stewart complete the book.

Practical Urinalysis and Urinary Diagnosis. By CHARLES W. PURDY, M. D., Chicago. (F. A. Davis Company, 1900.)

This is the fifth edition of Dr. Purdy's book and contains much new matter. The amount of work done by the author

<sup>1</sup> Second edition, revised.

on centrifugal analysis is well known, and in this new edition many more data for quantitative determinations by this method are given. These should be of much assistance clinically, as estimations can be made in a comparatively short time. There is an excellent section on the methods of microscopical examination, in which emphasis is put on the characteristics of the so-called false casts. This is an important point, as few works on this subject give more than a brief description of theory, and too often they are mistaken for hyaline casts. Dr. Purdy is to be congratulated on this last edition, which we expect to find as helpful as we have previous ones.

**Clinical Examination of the Urine, and Urinary Diagnosis.** By J. BERGEN OGDEN, M. D., Boston. (*Philadelphia: W. B. Saunders & Co., 1900.*)

There are so many good works on this subject that the need of another one does not seem very evident, and an author, in presenting a new book, requires to make good his right for recognition. While Dr. Ogden has produced a good book, we doubt if he has furnished a more complete guide to urinary analysis than any single volume yet published, which he states was his aim. The work is divided into two parts, the first dealing with the chemical and microscopical methods of examination, and the second part dealing with urinary diagnosis. The first is much the more satisfactory part of the volume. The tests and methods are clearly described. The first place in the detection of albumin is given to the cold nitric acid test. In the second part of the book the author appears to have gone to very great lengths in making numerous more or less artificial classifications. Thus, under the heading of hyperemia, there are five different conditions described. These complicated divisions are not likely to help the study of kidney disease and urinary diagnosis. In the section on the urine of typhoid fever more than a brief mention might have been given to the question of the occurrence of the bacilli in the urine. The statement that the sediment of typhoid urine "is almost certain to contain . . . a variable quantity of blood, usually a small amount," seems rather a startling one, and it would have been of interest to have had definite statistics given. The majority of writers, in discussing the urine of typhoid fever, fail to note that if large amounts of water be given, as ought to be the case, the classical description of the urine does not hold true. The urine will be abundant and of low specific gravity even early in the disease.

**Lectures on Clinical Medicine.** By JOHN LINDSAY STEVEN, M. D., Physician to the Glasgow Royal Infirmary. (*Glasgow: Alex. Macdonald, 1900.*)

This volume contains a number of lectures delivered by Dr. Steven in the Glasgow Royal Infirmary. They have previously been published in various periodicals. There are fifteen lectures in the book on various subjects, of which those on Landry's Paralysis, Osteo-arthritis and Scleroderma are perhaps the most interesting. Some more common clinical problems are also discussed, one lecture being devoted to paracanthosis thoracis. The book is interesting, and additional value is given to it by the excellent illustrations.

**Atlas and Epitome of Gynecology.** By DR. OSKAR SCHAEFFER, Privat-Dozent of Obstetrics and Gynecology in the University of Heidelberg. Authorized Translation from the Second Revised and Enlarged German Edition. Edited by Richard C. Norris, A. M., M. D., Surgeon-in-Charge, Preston Retreat, Philadelphia, Pa. (*Philadelphia: W. B. Saunders & Company, 1900.*)

As mentioned by the author in his preface, the book "occupies a position midway between the quiz compend and the more pretentious works on gynecology." The arrangement adopted is different from that usually seen in gynecological works, the

contents being considered in the five following groups: I. Anomalies of Formation and Arrested Development. II. Changes of Shape and Position. III. Inflammatory and Nutritional Disturbances. IV. Injuries and their Consequences. V. New Growths.

Group I is short and to the point, and from it the student will gain much information. On page 36 the writer says that passive hyperemia of the endometrium is essential as a cause of "congestive endometritis." Congestion naturally produces a thickening of the endometrium, but in no way institutes an inflammatory process. The causes of sterility as set forth on pages 46 and 47 will be of practical interest not only to the student, but also to the practitioner.

On page 73 the reader is informed that the most frequent causes of uterine displacement are perimetritic and parametritic exudates. Misplacements do certainly occur as a result of inflammatory exudates in the tubes or broad ligaments, but in the great majority of cases the altered position is due to a loss of tone in the uterine supports or to rupture of the perineal body.

The histological drawings are particularly instructive, especially those relating to the endometrium. Figures 2 and 4 on Plate 30 might, however, be justly described as normal endometrium, as the mucosa in the healthy individual often presents precisely the same pictures. The author follows the orthodox but erroneous plan of considering eversion of the cervical mucosa (or an occasional extension downward of the mucosa, lining the cervical canal) as erosion, although he admits that the supposed ulcerative area is covered by "pathologic cylindrical epithelium."

Numerous authors speak of a dozen or more varieties of endometritis. In this book the number is reduced to eight. In subsequent volumes the classification will probably become still simpler until all cases can be brought under acute, chronic, and, possibly, polypoid forms.

On page 122 we note with satisfaction the statement that in bimanual examinations of patients suffering from acute salpingitis "the greatest gentleness must be exercised in order to avoid the rupture of an abscess or the destruction of an existing encapsulation." The treatment of acute peritonitis accompanying salpingitis is rather antiquated, but Norris here comes to the rescue with editorial notes, giving recent American treatment.

The author is most patient in his treatment of inflammatory cases, and counsels against the removal of the ovaries except "when persistent treatment for years has failed." It is certainly refreshing to find such a conservative man. This conservatism, however, may be carried too far, as on page 201, where he advocates tapping parovarian cysts. Norris here again gives the appropriate advice—"celiotomy and complete removal should take the place of tapping."

The author says (page 137) that the histological differential diagnosis between tuberculosis of the endometrium and carcinoma of the body "is by no means easy." This is erroneous, as the two processes hardly resemble one another in any particular.

Repair of the peritoneum is considered at some length, and here also we are indebted to Norris for the main features of treatment. In the consideration of complete tears we are told that "the edges of the rectal tear must also be freshened and must be united by suture," but little stress is laid on the essential feature—the careful dissection and suture of the two ends of the muscle.

The diagrammatic drawings (pages 166 and 167) illustrating the various urinary fistulae are most instructive. The essential features of tubal pregnancy are also carefully dealt with, but we cannot agree with the author when he relies "on absorption" instead of operative means. The best results are to be



obtained where the pregnancy is diagnosed and the tube removed before rupture.

Larger new growths (page 185) most polypi springing from the mucosa are said to be due to "circumscribed inflammatory proliferation," when, as a matter of fact, few polypi show any evidence of inflammation except when exposed to outside influences. Under ordinary circumstances they should be considered as partial extrusions from the normal mucosa. Primary carcinoma of a myoma is said to occur (page 204). Such a change in a pure myoma is impossible, as no epithelial elements are present.

The chapter on "Cancer of the Uterus" contains much valuable information and the symptoms are carefully given. Here again the treatment advocated falls far short of the lines indicated by microscopical examination. "If an epitheliomatous papilloma is certainly limited to the cervix, one or both lips of the os and the affected portion of the vaginal vault may be removed." In every case where carcinoma is present the uterus must be removed, as we can never be sure how far the malignant growth has progressed.

The book contains much valuable material, but the new arrangement adopted makes its reading very fragmentary. The labor expended in the preparation of the drawings must have been very great, and rarely have we seen such a valuable collection of gynecological plates. With a more consecutive and somewhat fuller text, which we hope will accompany the next edition, this will be a useful book for both student and practitioner. In the present edition, indeed, the illustrations alone are more than worth the price of the book.

*A Text-Book of Diseases of Women.* By CHARLES B. PENROSE, M.D., Ph.D. Third Edition, Revised. (Philadelphia: W. B. Saunders & Co., 1900.)

A review of this work is to be found in the Johns Hopkins Hospital Bulletin, Vol. IX, p. 21, where its merits are discussed. That it has been well received is evidenced by a third edition in so short a period. In the present volume a short account of kraurosis vulvæ has been added on page 46, and on page 500 a note wisely advocating saving the tube and ovary when a parovarian cyst is being removed. Apart from these slight additions the book is practically the same.

*Cancer of the Uterus.* By THOMAS STEPHEN CULLEN, M.B. (Toronto), Associate Professor of Gynecology in the Johns Hopkins University. With Eleven Lithographic Plates and over Three Hundred Colored and Black Illustrations in the Text by MAX BRÖDEL and HERMAN BECKER. (New York: D. Appleton & Company, 1900.)

Whenever carcinoma of the uterus has passed from its point of origin, so that the surrounding tissues have become involved, or the adjacent glands are already the seat of metastases, the skill of the most experienced operator can avail nothing as regards a radical cure. Palliative measures alone can be resorted to, the patient, despite all our efforts, finally succumbing to a septicæmia from a terminal infection, a toxæmia from the absorption of poisonous necrotic material or to a uræmia following the blocking of one or both ureters. In view, then, of these constant reminders of our helplessness in dealing with the majority of malignant processes of the uterus, the present work must be regarded as a most welcome addition to medical literature, inasmuch as it not only clearly defines our present position, but also contains a wealth of personal, practical observations, clinical and pathological, as well as a judicious review of the best recent literature dealing with the subject. Briefly, Cullen's book, although not supplying us with a cure for cancer of the uterus, nevertheless, by enlightening us with regard to the most recent progress in the study of the pathology, etiology,

treatment and prognosis of such conditions, renders us familiar with the most advanced methods along lines which, in the future, may give a still larger measure of operative success.

As to permanent cure, it suffices to say that at the present time the successful cases are infinitesimally few in number as compared with the overwhelming majority of failures. In view of this fact, we are glad that the author from the very first page has emphasized the necessity of an early diagnosis, pointing out, as is too well known, that the symptoms and signs in these insidious processes are usually meagre. Thus he strenuously advises that in all cases in which the slightest hemorrhage occurs that cannot be satisfactorily explained, an immediate resort to vaginal examination and, as a rule, to a diagnostic curettage, is absolutely necessary. Furthermore, he goes on to say: "It is upon the family physician that we must rely to recognize the early symptoms and to indicate to the patient the appropriate treatment." This necessity for employing every possible means for detecting a malignant growth in its incipency—at the one stage at which cancer is curable—is enforced again and again by precept and by the records of actual cases.

Following this introduction, which supplies the author with a text, with which all his colleagues must be in complete sympathy, are twenty-six chapters, making in all about 700 pages, dealing with every phase of carcinomatous processes of the uterus, fully illustrated by appropriate cases, which have been followed from the operating-room, through the laboratory to their ultimate termination, so far as could be discovered up to the time at which the book was published.

In Chapter II is found a new and instructive drawing which shows very prettily the anatomical subdivisions of the uterus. It is to be regretted that Peiser's recent research had not met the author's eye before the book went to press. Peiser has called especial attention to a set of lymphatic vessels which curve backwards from the base of the broad ligaments and, after coursing through the uterosacral ligaments, empty their contents into bead-like glands along the sacrum. It seems certain that these lymphatic tracts must play a larger part in the development of pelvic metastases than has hitherto been attributed to them.

Accompanying his description of the normal uterine mucosa, Cullen gives several excellent illustrations of the variations incident to increasing age in women. There is no doubt that ignorance of the normal changes in the endometrium is responsible for many mistakes in diagnosis from curettings, mistakes which have not infrequently brought the pathological method of diagnosis into disrepute in the eyes of the somewhat skeptical clinician. Thus, only recently the reviewer came across a specimen almost identical with that shown in Fig. 13, representing a normal cervical mucosa, which had been diagnosed as an adenocarcinoma. To any student who would avoid such mistakes this chapter is particularly instructive, since Cullen shows us the bizarre appearances of the uterine glands when cut at varying angles to the peculiar invaginations seen in normal glands, which might sometimes prove puzzling at first even to a trained microscopist.

With reference to the acute shedding of the superficial portion of the endometrium at the time of the catamenia, which has hitherto been generally taught, Cullen says: "For six years we have paid especial attention to this point and thus far have always found the mucosa intact throughout the monthly period, there being no loss of substance whatever."

Pursuing the subject in regular sequence, in Chapter III, which deals with the removal and examination of uterine tissue for diagnostic purposes, Cullen gives explicit directions for dilatation and curettage, together with the various methods for preserving tissues so that the best possible specimens for microscopic examination can be obtained. The general practitioner is not expected to have the time, even if he has the training,



for an elaborate study of microscopical specimens, but just as an amateur photographer may take a picture and then leave the development of it to the skilled professional, so the practicing physician may curette properly, and later send to a competent pathologist specimens preserved in such a way that they are suitable for study. If Cullen's directions were always carefully followed, there would be fewer reports that the scrapings are insufficient or too unsatisfactory for diagnosis.

In Chapter IV, which deals with squamous-cell carcinoma of the cervix, a classification essentially the same, but differing verbally from that of Winter and Ruge is adopted. On the whole, however, for the sake of avoiding confusion, we think it would have been better if the older classification had been maintained.

The transition of the normal into seriously involved tissue is described in detail and well illustrated by appropriate pictures.

Chapter V gives the various routes of extension. The author's statement, that "if the broad ligament is involved to the extent of being palpable, the patient is doomed," is in accord with the view of Freund and other prominent gynecologists. The fact that the liver is so rarely involved in metastatic processes shows that cancer of the uterus differs from cancer of the breast, inasmuch as, in the latter, an early occurrence of widespread lymphatic metastases is the rule. Hence it is to be hoped that, when an early diagnosis is made, cancer of the uterus may still be strictly localized and readily amenable to treatment.

Chapter VII, in which the various pathological processes which might possibly be compared with carcinoma are dealt with, affords very instructive reading.

In his review of the treatment (Chapter VIII) Cullen mentions, as one of the most important advances in operative procedure, the placing of catheters in the ureters. Werder's operation also is fully detailed and highly commended. The accidents which may occur during operation, especially those performed through the vagina, are discussed. Cullen on the whole inclines to the abdominal, and in this view is in accord with the majority of American operators.

It is to be regretted that the author does not refer to the excision of cancerous tissue by means of the thermocautery, a procedure which has proved very successful in the hands of Dr. T. Byrne of Brooklyn.

Chapters IX to XIII and Chapter XVII deal with adenocarcinoma. Chapter XV is especially valuable as showing that a clinically benign growth may sometimes be associated with malignant disease. Other conditions and deciduoma malignum are discussed at length.

The tabulation of cases studied by Cullen affords much interesting information. It is refreshing to note that while the results, as shown in the table, are most depressing, Cullen hopes for much better results in the near future, since he believes early diagnoses will become much more common. We should be inclined to share in this optimistic view were it not for the fact that in the last week we have encountered three inoperable cases in which the disease had been so insidious that the patients had first complained to their family physician only a few days previous to admission to the hospital.

The various theories dealing with the cause of carcinoma are discussed, but the conclusion is reached that "the etiology is still an unsettled question." Reference is made to inoculation experiments pointing to the possibility of the implantation of carcinomatous tissue on a healthy surface, and the operator is warned to guard against this danger.

The book concludes with an extensive quotation from a paper by G. T. Knowlsey Thornton, entitled "A Plea for the Early Diagnosis of Malignant Disease of the Uterus."

While feeling that unstinted praise is due to this magnificent monograph, the reviewer regrets that, as the book is intended

for all classes of physicians, the matter has not been arranged somewhat differently. The first half of the book might well have been devoted to an unbroken, epitomized narrative of the author's own work and his conclusions, which might have been followed by his splendid array of illustrative cases. With the present arrangement it is to be feared that not a few readers will fail to extract all the rich meat which the book contains. At the same time it must be said that this defect is one of very few among the many excellences, which have evidently resulted from indefatigable personal research and a thorough understanding of the subject.

The value of the subject-matter has been materially advanced throughout by the excellent original drawings of Messrs. Brödel and Becker, and the author has every reason to be satisfied with the way in which the publishers have presented his work to the public.

### BOOKS RECEIVED.

*Twentieth Century Practice. An International Encyclopedia of Modern Medical Science by Leading Authorities of Europe and America.* Edited by Thomas L. Stedman, M.D. In twenty volumes. Volume XX. Tuberculosis, Yellow Fever, and Miscellaneous. General Index. 1900. 8vo. 906 pages. William Wood and Company, New York.

*Metropolitan Asylums Board. Annual Report, 1899.* (In two volumes.) Vol. II. Fourteenth Report of the Statistical Committee with Appendices. 1900. 8vo. McCorquodale & Co., Limited, London.

*Twenty-sixth Annual Report of the Secretary of the State Board of Health of the State of Michigan,* for the fiscal year ending June 30, 1898. By Authority. 1900. 8vo. CXIX + 395 pages. Lansing.

*Transactions of the Medical Association of Georgia.* Fifty-first annual session, 1900. 8vo. 421 pages. 1900. Published by the Association, Atlanta, Ga.

*Selected Essays and Monographs.* (From foreign sources). By Various Authors. 1900. 8vo. 306 pages. The New Sydenham Society, London.

*Transactions of the American Ophthalmological Society.* Thirty-sixth Annual Meeting, Washington, D. C. 1900. 8vo. 200 pages. Published by the Society, Hartford.

*Report on the Mortality Records of the Mutual Life Insurance Company, of New York, for Fifty-six Years.* From 1843 to 1898. By Elias J. Marsh, M.D., and Granville M. White, M.D. 1900. 4to. 245 pages. The Mutual Life Insurance Company, New York.

*Transactions of the American Surgical Association.* Volume the eighteenth. Edited by De Forest Willard, M.D., Ph.D. 1900. 8vo. XXVIII + 468 pages. Printed for the Association, Philadelphia.

*Transactions of the Louisiana State Medical Society.* Twenty-first annual session held at New Orleans, La., April 19, 20, 21; 1900.

*Rhinology, Laryngology and Otology and their Significance in General Medicine.* By E. P. Friedrich, M.D. Authorized translation from the German. Edited by H. Holbrook Curtis, M.D. 1900. 8vo. 348 pages. W. B. Saunders & Company, Philadelphia and London.

*A Manual of Syphilis and the Venereal Diseases.* By James Nevins Hyde, A.M., M.D., and Frank Hugh Montgomery, M.D. Second edition, revised and enlarged. 1900. 8vo. 594 pages. W. B. Saunders & Company, Philadelphia.

*Studies in the Psychology of Sex.* The Evolution of Modesty. The Phenomena of Sexual Periodicity. Auto-Erotism. By Havelock Ellis. 1900. 8vo. 275 pages. The F. A. Davis Company, Philadelphia. New York, Chicago.

*A Text-book upon the Pathogenic Bacteria.* For students of medicine and physicians. By Joseph McFarland, M. D. Third edition, revised and enlarged. With 142 illustrations. 1900. 8vo. 621 pages. W. B. Saunders & Company, Philadelphia.

*A Text-book of the Diseases of Women.* By Henry J. Garrigues, A. M., M. D. Third edition, thoroughly revised. With 367 illustrations. 1900. 8vo. 756 pages. W. B. Saunders & Company, Philadelphia.

*Bacteriology and Surgical Technique for Nurses.* By Emily M. A. Stoney. Illustrated. 1900. 12mo. 190 pages. W. B. Saunders & Company, Philadelphia.

*An American Text-book of Physiology.* Edited by William H. Howell, Ph. D., M. D. Second edition, revised. Volume I. 1900. 4to. 598 pages. W. B. Saunders & Company, Philadelphia.

*A Book of Detachable Diet Lists.* For Albuminuria, Anæmia and Debility, Constipation, Diabetes, Diarrhœa, Dyspepsia, Fevers, Gout or Uric Acid Diathesis, Obesity, Tuberculosis, and a Sick-room Dietary. Compiled by Jerome B. Thomas, Jr., A. B., M. D. Second edition, revised. 1900. W. B. Saunders, Philadelphia.

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